World Petroleum

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MARCH, 1952

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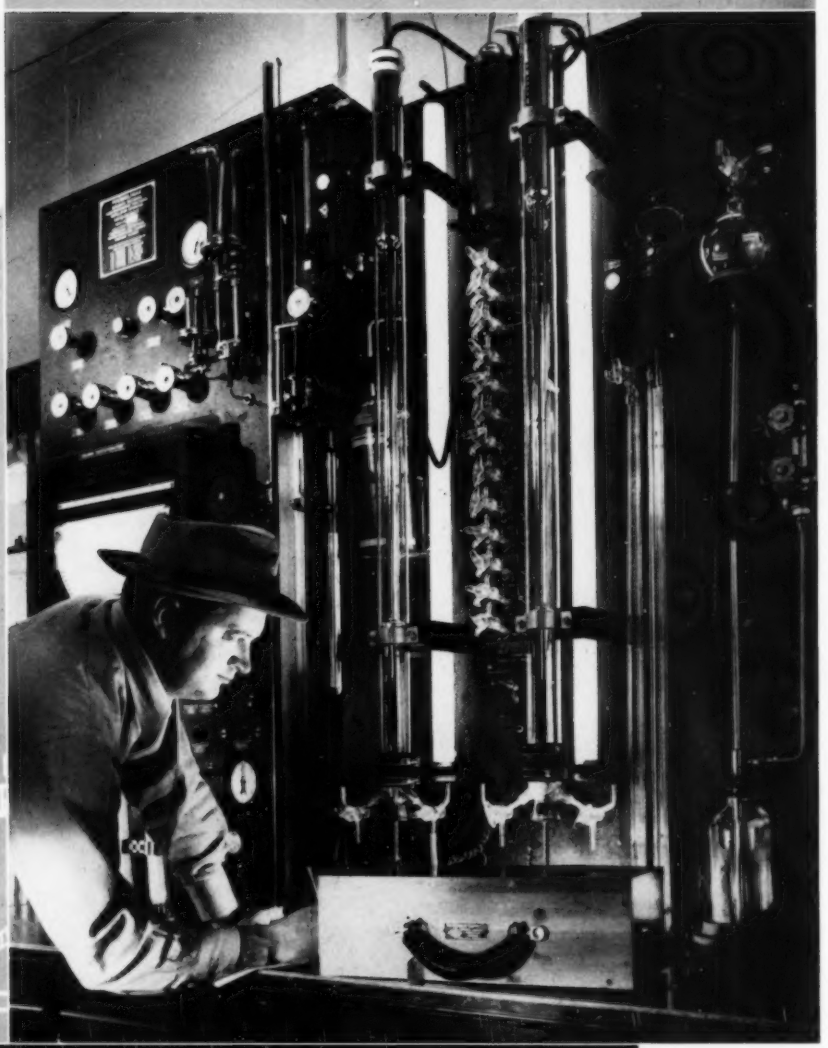
7. RESEARCH

Complete and continuous research and testing by Warren's two Research Laboratories.



WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

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30 YEARS' SERVICE

Crude Oil, Natural Gasoline and Liquefied Petroleum Products

Storing Motor Fuel in Netherlands Antilles

This group of twenty-two Hortonspheroids is storing motor fuel at 2½ and 5 pounds pressure for Royal Dutch Shell on the island of Curacao in the Netherlands Antilles.

In the Caribbean area and throughout the world Hortonspheroids have proven their ability to efficiently store petroleum products ranging in volatility from motor gasoline to natural gasoline. They will not vent so long as internal pressure does not exceed the setting of the relief valve. Evaporation losses caused by boiling — filling losses — and breathing losses are greatly reduced or eliminated all together.

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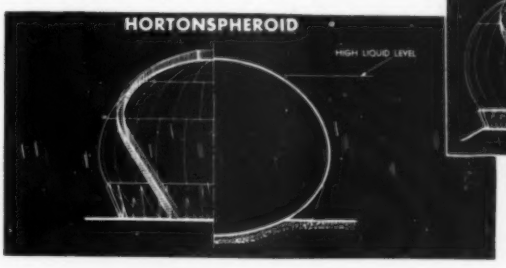
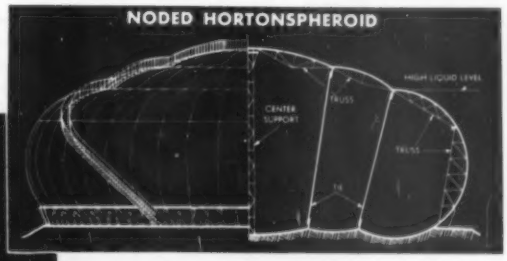
For more complete information about Hortonspheroids, Hemispheroids, Hortonspheres, Vaporspheres, Horton Vapordrome tanks or any other Horton storage tank, write our nearest office. There is no obligation on your part.



Plain Hortonspheroids are built in standard capacities from 2,000 to 40,000 bbls. for 2½ to 30 lbs. per sq. in. pressure.



Noded Hortonspheroids are built in standard capacities from 20,000 to 120,000 bbls. for 2½ to 20 lbs. per sq. in. pressure.

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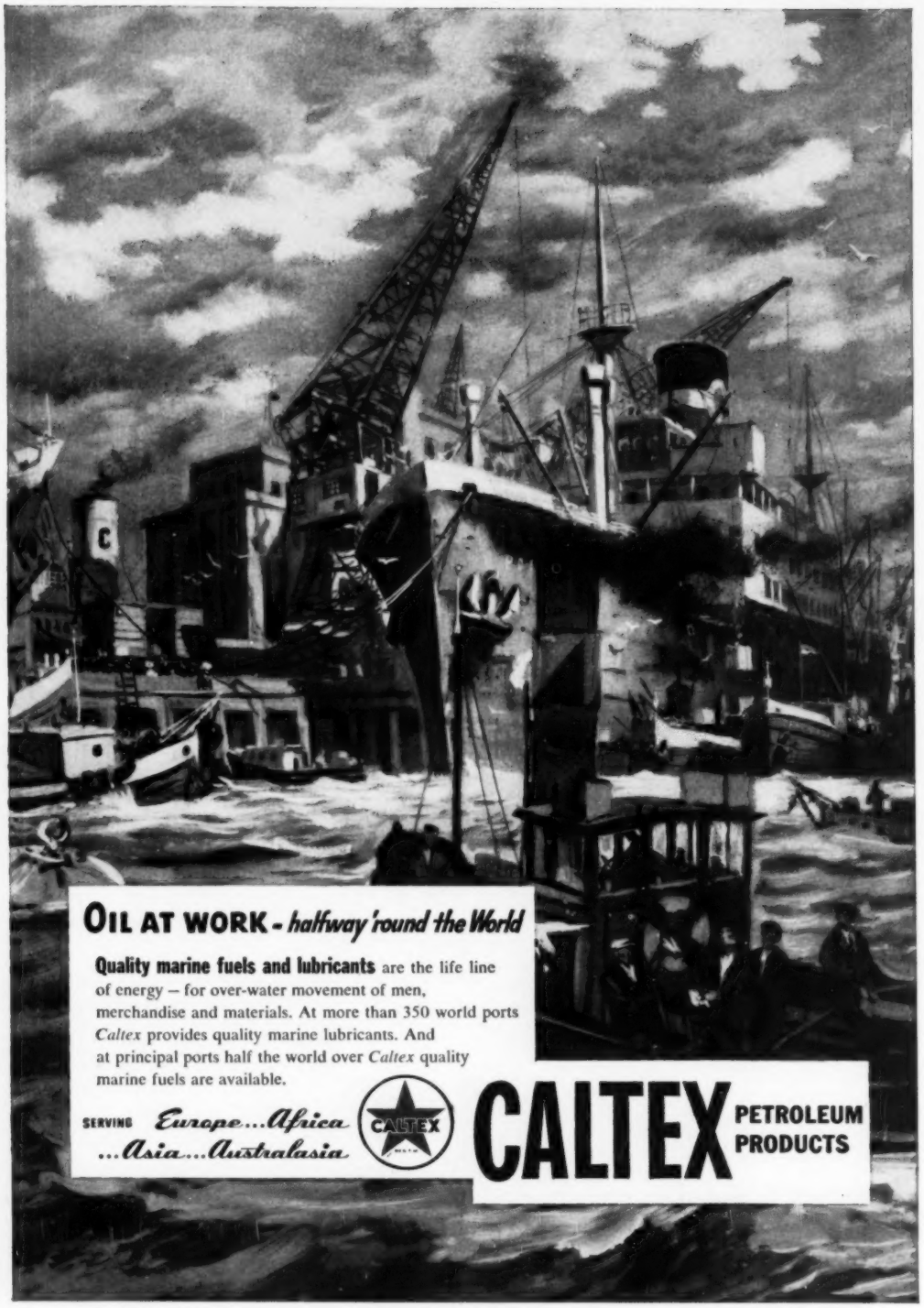
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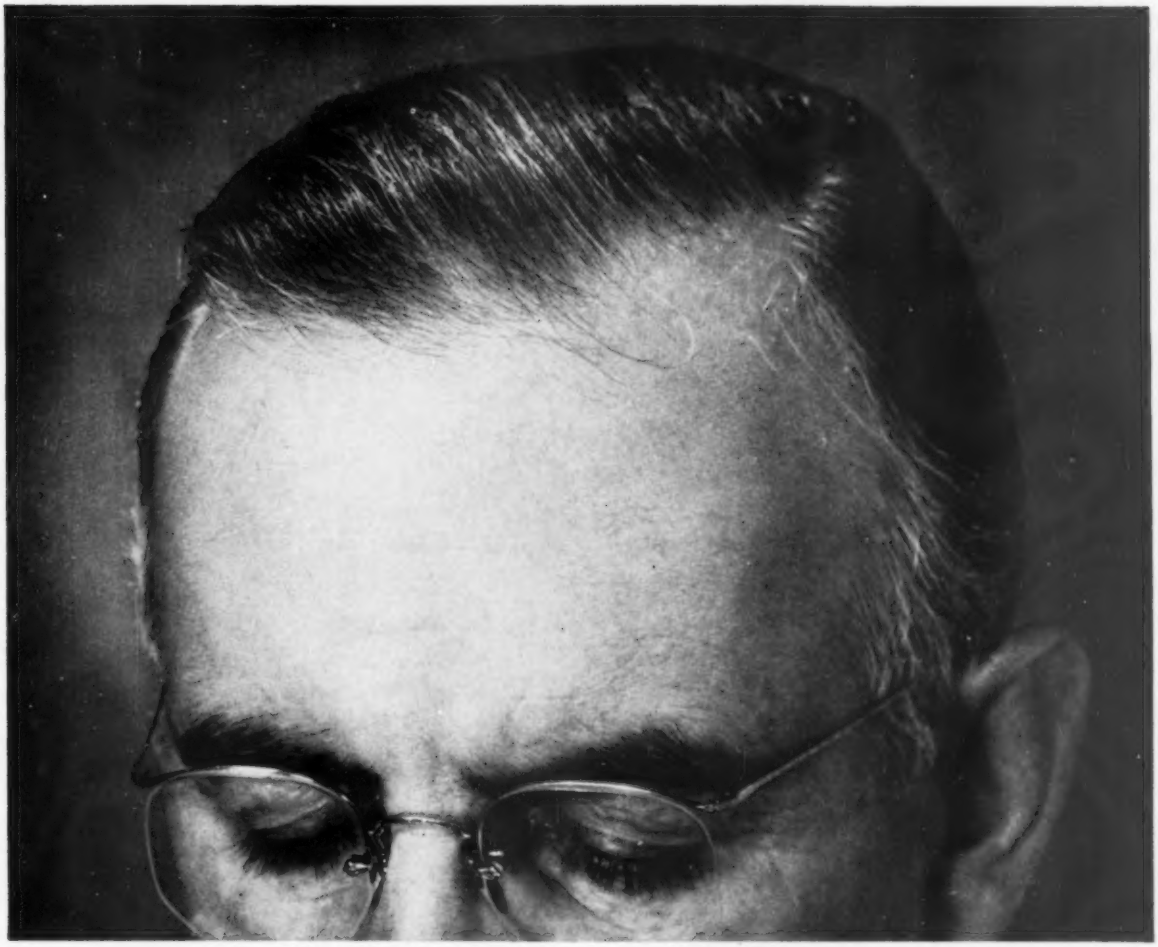

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Ethyl has been building its research and service teams for over twenty-eight years. Many of our original people are still with us. They form the nucleus of an organization which now includes over four hundred fuel, antiknock and engine specialists, and one hundred and fifty representatives in the field. These people are not only individually capable, but they have worked and developed together as a team so that their collective value to Ethyl customers is far more than the net total of their individual capabilities.

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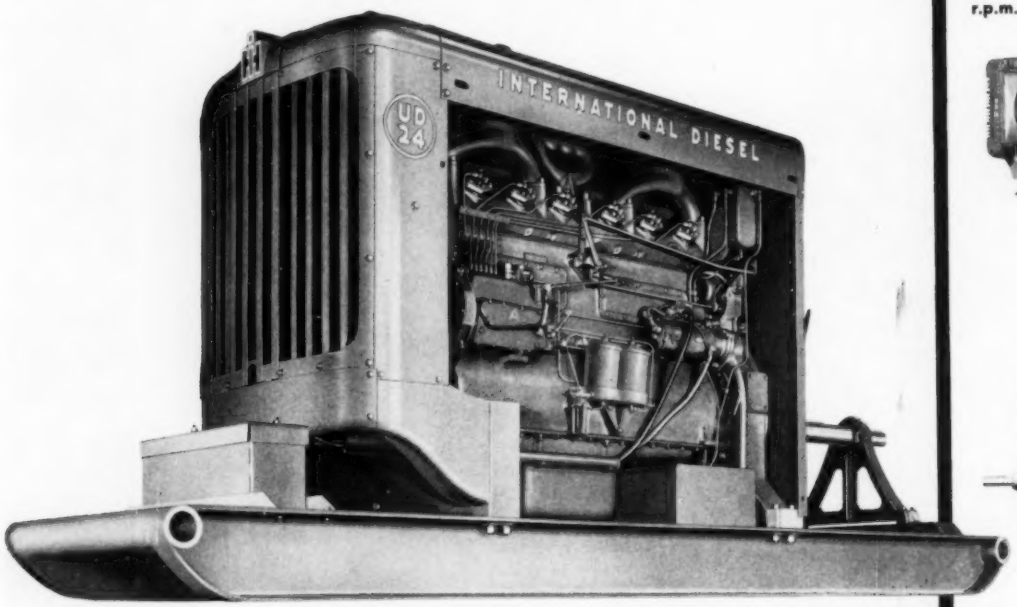
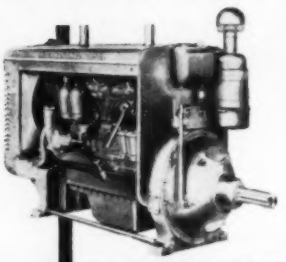
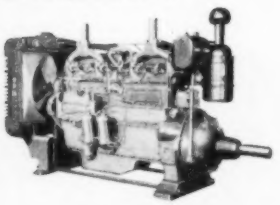


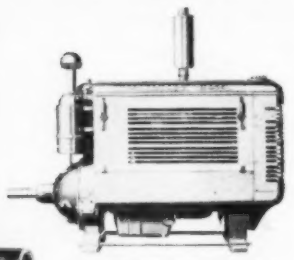
UD-24, 180 h.p. at 1,375 r.p.m. 6-cylinder Diesel



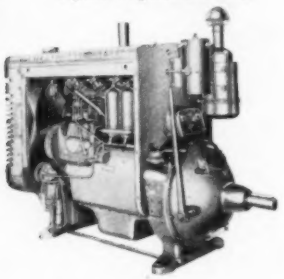
UD-18A, 125 h.p. at 1,600 r.p.m. 6-cylinder Diesel



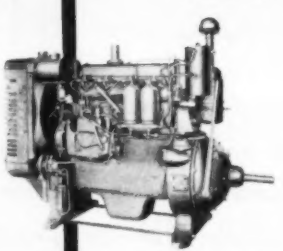
UD-16, 100 h.p. at 1,800 r.p.m. 6-cylinder Diesel



UD-14A, 76 h.p. at 1,400 r.p.m. 4-cylinder Diesel



UD-9A, 62.5 h.p. at 1,500 r.p.m. 4-cylinder Diesel



UD-6A, 45 h.p. at 1,600 r.p.m. 4-cylinder Diesel

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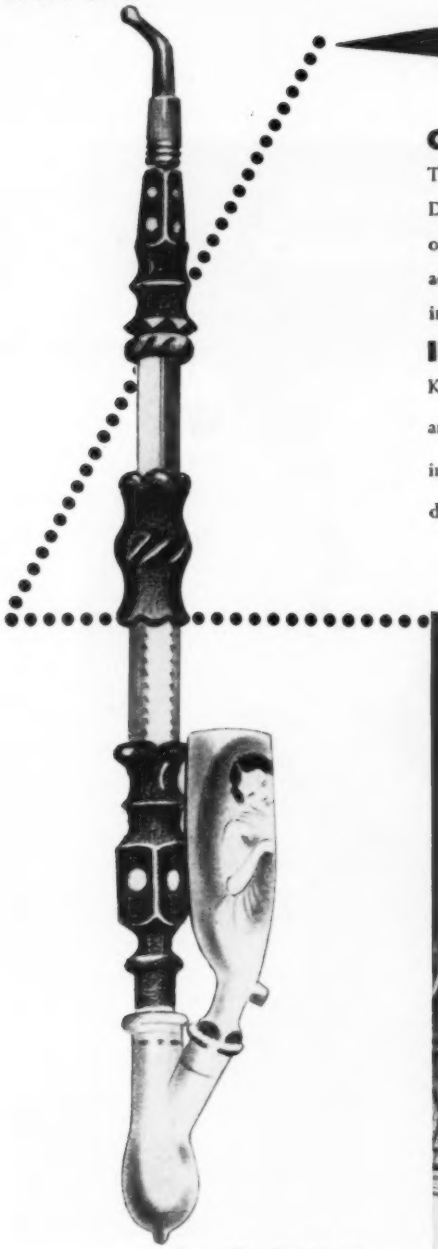
TALKING OF PIPES



from "The Pipe Book"
by Alfred Dunhill

GERMAN PORCELAIN PIPE

The typical Central European pipe of today can be traced to the eighteenth century Dutch clay. The stem is, however, broken short and the bowl is inserted into a holder or base. By this arrangement, both bowl and stem are upright and the deleterious tobacco juices drain down into the holder. Such a pipe is capable of infinite variations in decoration.

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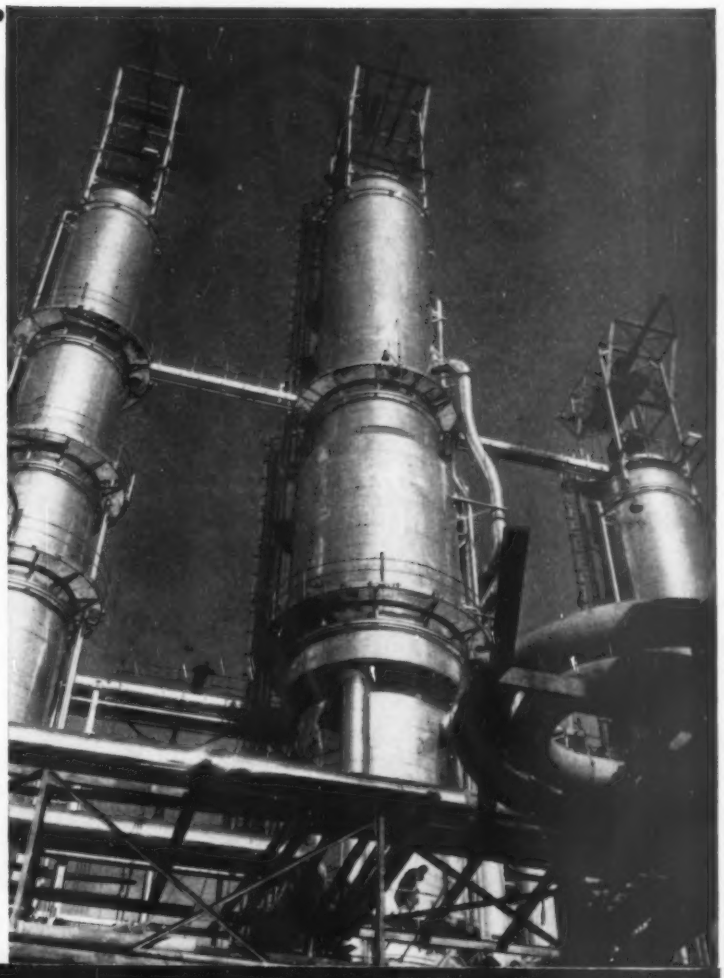

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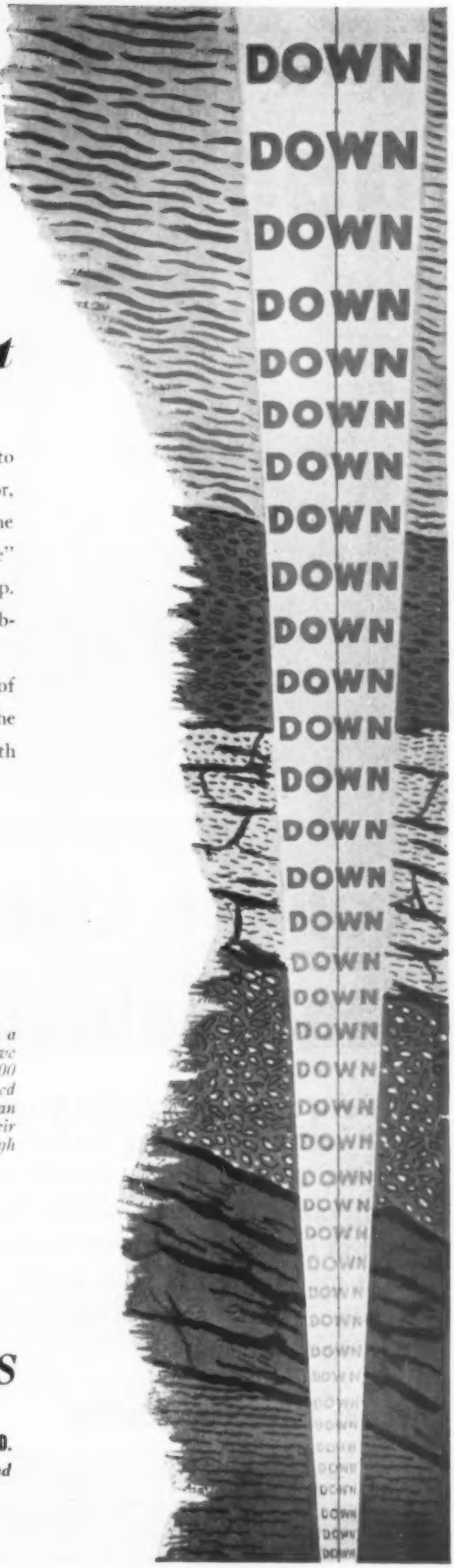
The ever-increasing demands of an oil-thirsty world require drilling to greater depths in sinking wells. Higher engine powers are called for, and to meet this need Paxman diesel engines are being used. The power-unit in most common use is the RPH class Paxman "Package" set. This 7" x 7¾" vee-form 12 cylinder engine is rated at 400 b.h.p. at 1,000 r.p.m. The engine unit being mounted within a special sub-frame carrying the drive.

The layout of this "Package" set permits easy exchange or service of the engines. It is a compact, self-contained unit which, by virtue of the robust skid-type underbase, can be handled on and off transport with ease.

Three of these units, forming a compound outfit of 1,200 b.h.p. have been drilling to a depth of 15,000 feet in Venezuela, and have proved the adaptability of the Paxman "Package" sets, as well as their ability to stand up to really rough handling and rigorous work.



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DIESEL POWER UNITS

DAVEY, PAXMAN AND COMPANY LIMITED, COLCHESTER, ENGLAND.
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After Corexit is injected or batch-dumped into the well annulus, it gradually builds up a protective coating inside the tubing and on the sucker rods to prevent new corrosion. Where corrosion has already started, tests show that Corexit seeks out pits and other corroded spots and coats them first, to check further corrosion.

Prevents Hydrogen Embrittlement

Many sucker rod failures can be traced to hydrogen embrittlement. On old sucker rods, Corexit coats the corroded spots, preventing the entrance of additional atomic hydrogen. On new sucker rods, Corexit combats hydrogen embrittlement

Try Corexit for six months, and note the substantial savings. Write for information.

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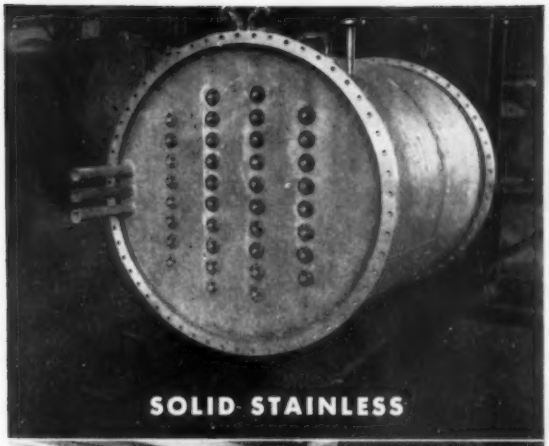

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Here are excellent examples of Graver's ability to satisfy the diverse requirements of the petroleum and process industries. Fabricated to conform with standard codes or special requirements, these towers are the result of Graver's long experience in manufacturing quality vessels in steels, clads and alloys.

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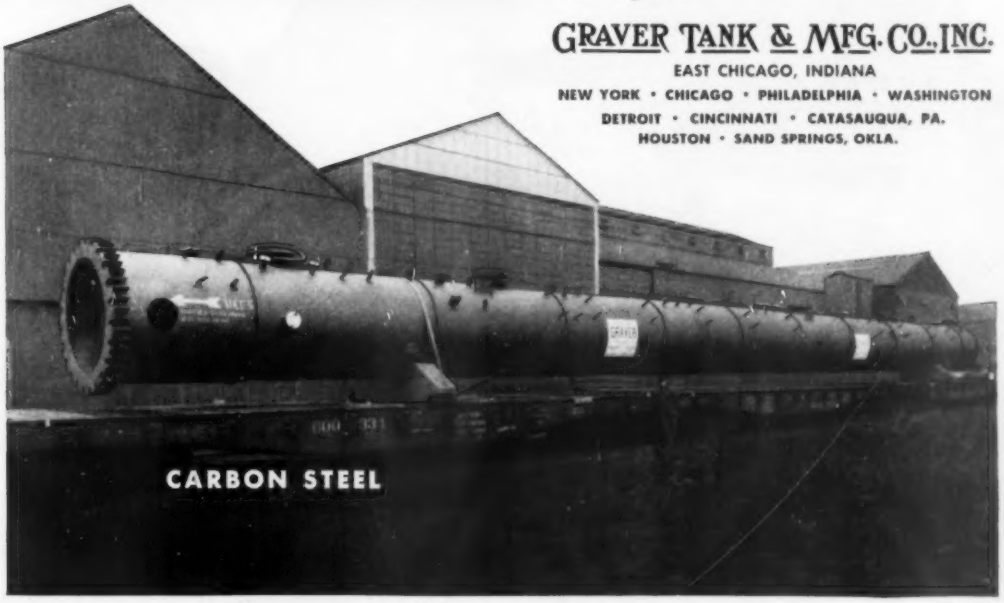

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(BUT s·m·o·o·t·h!)

This is the Bethlehem Tornado—a deep-drilling, power-loaded giant that's brimming with get-up and go. For depths to 13,000 ft it's a rig that has everything.

Power, power, power! But smoothness, too. And ease of operation. Ask any driller how he likes it. Ask him how he likes the air controls; the self-adjusting clutches. He'll tell you that here's a rig as simple to handle as many a smaller outfit. Chances are he'll tell you, too, that its action is practically shock-free. None of the jolts and jarring take-ups of loads so common in other big rigs. (The answer: cushioned transmission.)

We don't know of any other drawworks in its class that so well combines both power and smoothness. This is a fact that can easily be verified in the field where Bethlehem Tornados have been used for deep drilling. Write for information; complete details will be sent promptly.

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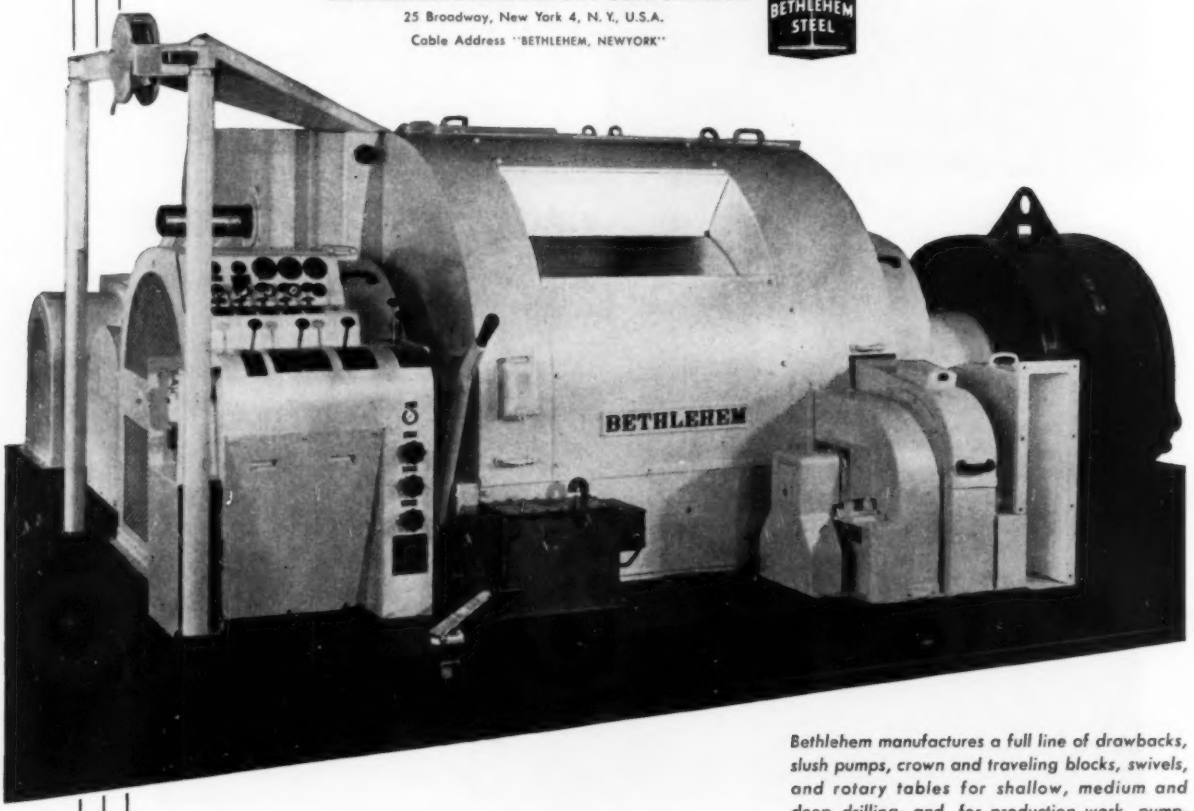
BETHLEHEM STEEL



Bethlehem manufactures a full line of drawbacks, slush pumps, crown and traveling blocks, swivels, and rotary tables for shallow, medium and deep drilling; and, for production work, pumping units in a wide range of sizes and types.

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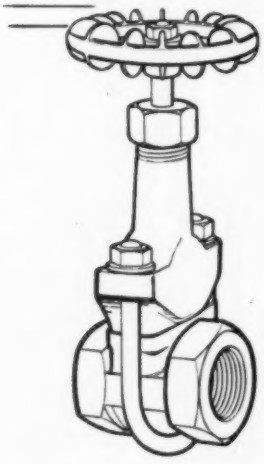

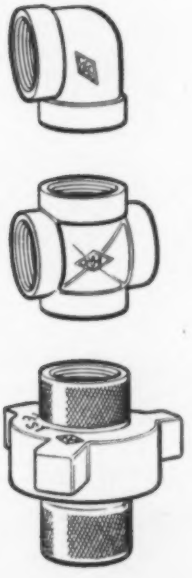

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We were proud, and had reason to be, of the Howco men of 1924. "We'll Get There Somehow" was their slogan, and somehow they always did. The Howco men of 1952 are cut from the same cloth, but infinitely better equipped—with modern bulk plants to speed and improve the handling of cement, specially designed marine equipment for offshore operations, and land cementing equipment that represent more than a quarter-century of continuous development. Yet, despite skyrocketing costs, the service that these men render costs LESS today than in 1924!

Erle P. Halliburton
Chairman of the Company
HALLIBURTON OIL WELL CEMENTING CO.
Duncan, Oklahoma

PETROLEUM CHEMICALS DIVISION

NEWS

March ★ One of a Series of Interest to the Petroleum Industry ★ 1952

"New Look" for Du Pont Quarterly Motor Gasoline Survey

Just as gasolines are tailored to meet seasonal driving needs, the 1952 covers for Du Pont's Quarterly Motor Gasoline Surveys have been redesigned to portray the season in which they appear. This change is intended to make for quicker identification of any desired issues.

The January 1952 cover showed a snow-flaked winter service station scene. In the background was a map of the United States and Canada, indicating the extensive territory covered by the survey.

The April issue (due the week of April 21st) will carry out the seasonal theme with a spring scene.

Du Pont Historical Highlights

When the Du Pont Company was founded a century and a half ago, Federal Government income came almost entirely from customs duties. Taxes on the cost of manufacturing were almost unknown. Income, excess profits, franchise, sales, use, inheritance and social security taxes did not exist.

State taxes were levied chiefly on property and the State of Delaware's entire tax collection in 1802 amounted to less than $15,000 and total Federal income was $15 million.

Recent additions to the Du Pont Experimental Station alone cost more than $30 million, or twice as much as the entire Federal income in the year the Company was founded. And even the new Du Pont Petroleum Laboratory facilities would have taken a substantial bite from Uncle Sam's 1802 income if that gentleman had been required to pay the bill.

New Planning Staff will Coordinate Du Pont Facilities to Meet Petroleum Industry Needs

Because of the tremendous growth of the petroleum industry during the past decade, Du Pont is expanding its efforts to anticipate, as well as meet, the industry's petroleum chemicals requirements.

PLANNING MANAGER

T. BALDWIN PRICKETT was recently appointed Planning Manager of the Du Pont Petroleum Chemicals Division.

Mr. Prickett's previous activities and experience as refinery technologist for the division make him well qualified to take over his new duties of coordinating Du Pont's facilities to meet current and future needs of the petroleum industry.

His broad experience in chemical manufacturing includes work with the National Aniline and Chemical Company and the Pennsylvania Salt Manufacturing Company.

In 1931, Mr. Prickett joined Socony-Vacuum Oil Company and became assistant plant engineer in charge of initial development of the Houdry catalytic cracking process. He later became associated with the Houdry Process Corporation and affiliates as vice-president.

Just before he came to Du Pont in 1946, Mr. Prickett was in charge of commercial development of the Houdry process. He also directed the engineering, plant operations, and catalyst manufacturing activities of the Houdry Corporation.

To activate this program, the Du Pont Petroleum Chemicals Division recently organized a full-time planning staff.

Among the aims of this group will be long-range plans to assure ample supplies and convenient deliveries of all gasoline additives, plus the consideration of new product development to meet specific industry needs. These activities will complement the work of the Du Pont engineering laboratories and technical, automotive and other Du Pont petroleum industry service groups.

BROAD INDUSTRY STUDIES

To help keep the Du Pont Company informed on the growth and trends of the industry it serves, the planning group will base its studies not only on tetraethyl lead production, but on the broad foundation of all other factors contributing to supply and demand trends in the petroleum industry. Such a project calls for comprehensive studies of transportation facilities, technical refining developments and sources of supply for raw materials. Automotive and aviation engineering trends will be considered, too.

Although extremely broad in scope, the program is expected to result in many practical benefits for refiners. And, as the only manufacturer of a complete line of gasoline additives, Du Pont is keenly interested in continuing to serve the industry on as comprehensive a scale as possible.

To help accomplish the goal, the Du Pont Petroleum Chemicals Division is supported by research facilities that rank among the world's largest. Cooperating with these facilities on the development of new products to meet petroleum industry needs will be an important function of the new planning group. And the group will be constantly working to make Du Pont petroleum chemicals more exactly tailored to your specific refinery needs.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

New Du Pont Book Helps Small Refineries Set Up Safety Programs

"How can we set up an effective safety program in our refinery?"

That was a question frequently asked Du Pont by refiners operating plants with up to 2,000 employees. With a long established safety history and a keen interest in furthering safety throughout industry, Du Pont is regarded as a logical source of help in safety planning.

As a result of many requests, Du Pont recently published "Safety for the Small Refinery"—a 42-page book prepared with the help and cooperation of the National Safety Council. It tells, step by step, how to set up an effective refinery safety program and, more important, how to use the wealth of safety material available to refiners.

MANAGEMENT FUNCTION

While the foreman is a key man in any good industrial safety program, safety is also an important *function* of *every* job. And most important of

all, the safety program must gain its driving force from the active participation and interest of top management.

In this connection, the new Du Pont book outlines a basic safety philosophy around which refinery management can build its own policy. It also contains a suggested plan for setting up a refinery safety council of executives, and a safety committee drawn from plant personnel.

The book lists a wide range of general safety material available from the National Safety Council and the American Petroleum Institute. Typical monthly and yearly refinery safety programs are outlined in detail—on a day-by-day basis.

A copy of "Safety for the Small Refinery" is available to you through the nearest Du Pont Petroleum Chemicals Division district office.

DU PONT TANK CLEANING CLINIC GOES ON TOUR

Based on the request of a large oil company, the Operations Group of the Petroleum Chemicals Division has set up a discussion clinic on the hazards connected with entry of leaded storage tanks.

B. GARDNER CRANE, Director of the Du Pont Petroleum Chemicals Division Operations Group, conducting a typical refinery safety clinic.

Headed by B. Gardner Crane who directs the Du Pont Operations Group and Dr. Stewart L. Rankin, chief medical advisor to the Petroleum Chemicals Division, the clinic recently completed a tour of five refineries operated by the company requesting the service. The meetings met with enthusiastic approval, and the Operations Group is now prepared to take the clinic on tour for other refiners interested in the service.

Essentially, the clinic is a safety review program for terminal managers and group leaders directly concerned with tank cleaning. Informal, yet broad in scope, it discusses the main problems and precautions involved in cleaning leaded storage tanks.

COMPREHENSIVE PROGRAM

Basically, the clinic program covers the following:

1. Toxicity of tetraethyl lead compounds.
2. Order of magnitude of TEL hazards in leaded gasoline storage tanks.
3. Description of lead-free tank for purpose of entry without protective equipment . . . for both "cold" and "hot" work. The exceptions are also covered.
4. The mechanics of tank cleaning, including sludge disposal problems.
5. Description of use and limitations of Du Pont Lead-in-Air Analyzer.
6. Emergencies in handling tetraethyl lead compounds.
7. Question and answer session.

The program is quite flexible and can be readily varied to meet individual plant or company needs.

For information regarding the Du Pont Tank Cleaning Clinic, get in touch with your Du Pont Petroleum Chemicals Division district office.

Literature—Movies Available

Here is a partial listing of the movies, bulletins, reports, booklets and aids available to you through the nearest Du Pont Petroleum Chemicals Division district office:

Safety for the Small Refinery – A 42-page book on how to set up an effective small refinery safety program . . . . . Serial A-2848

Tank Talk – A 52-page, easy-to-understand safety booklet for tank-cleaning crews . . . . . Serial A-1134

Prints of the following Du Pont films are available to oil companies for training and public relations purposes. They may be borrowed or purchased.

Pipeline on Wheels—A 26-minute, full-color movie on tank truck safety. Suitable for both training and public relations purposes.

What makes a Gasoline Good – An 18-minute cartoon movie in color. Presents, in easy-to-understand form, the story of how high quality gasoline is made. Ideal for dealer training meetings.

In addition, Du Pont makes available a special library of films of particular interest to the petroleum industry.

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REG. U. S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • *Wilmington 98, Delaware*

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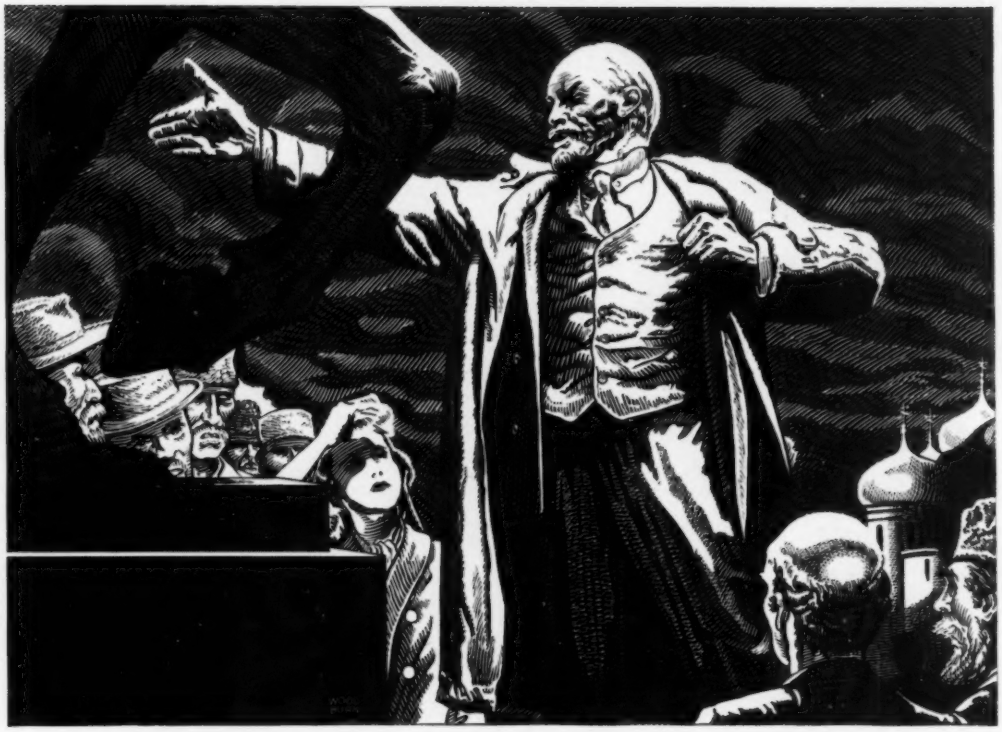

Let us prove this prophet false

"We shall force the United States to spend itself into destruction."

These are the words of Lenin, father of Russian Communism. Quoted from page 191, volume xxi, of his Collected Works, they were printed recently in a metropolitan newspaper.

This is the announced goal of the Politburo, and it is the direction in which many patriotic citizens fear we are headed. For example, Congress has just appropriated $87 billion to be spent during 1952, and enacted taxes estimated to produce only $71 billion. The deficit is to be added to our national debt, already $259 billion; and this deficit will depreciate the national currency by another $16 billion.

Part of this stupendous appropriation is to rearm ourselves and the free world against Communist attack. But what about the rest of our spending?... Let us also be realistic. It is time for us as a nation to pause, reflect and consider well. We can do three things to avoid national bankruptcy:

1. Eliminate every non-essential federal expense.
2. Provide taxes to pay all obligations as we go.
3. Pay off some of our national debt every year.

Let every citizen who believes in preserving our nation from the economic termites within, as well as from the announced enemy without, become an active worker to prove the Russian prophet false.

YOUR SCRAP IS NEEDED — YOUNGSTOWN

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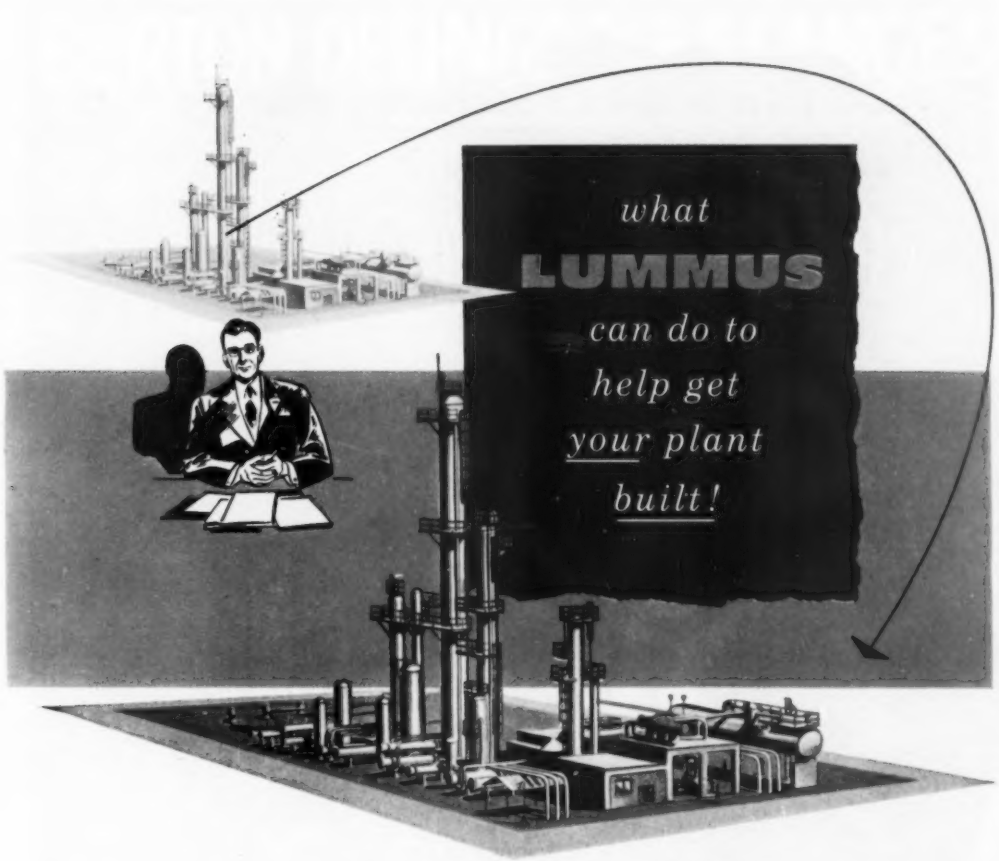
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.



Design, engineer and construct it? Of course. These three main classes of service—performed under *one* contract with *single* responsibility—are our bread and butter. They have produced more than 600 plants of all types in just about every country where petroleum is refined or chemicals are made.

Today's conditions, however, call for departures from "routine." Otherwise, endless complexities, shortages, etc., could require three times the normal effort to get a plant built. But Lummus has the quality and versatility of staff—the breadth and depth of operations, to meet these conditions head-on and help you maintain near-normal status.

It could work like this. In the interest of "first things first," you may need basic studies and reports covering alternative routes for reaching your goal. If so, rely on Lummus to develop analyses on which to base sound capital investment decisions.

Perhaps your problem is not so much with process units themselves, but with tying the whole system together for full operating efficiency. Lummus has long-established experience in laying out and installing complete off-site facilities—the bringing in of utilities—piping to introduce charge materials and carry off products—tankage, dockage, loading facilities, etc. This is "know-how" you can use to advantage.

Among other added factors are the considerable help we afford in procuring materials, and invaluable counsel in interpreting government rules and regulations—all in all, unique services geared to the times.

We invite you to use our various services, either singly or in combination—to get that plant *built!*

THE LUMMUS COMPANY

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DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

we had to do a reforming job
so naturally we bought

PLATFORMING

THAT'S entirely logical. Every refinery executive knows that a reforming job *must be done by a reforming process.* With that need in mind, Platforming was developed to provide the most efficient method of reforming low octane gasoline stocks into high octane products.

There are various jobs in a refinery that require a number of different processes. Where reforming is needed, Platforming fits the requirement perfectly. It is a true reforming process . . . specifically designed, engineered and constructed to meet the particular needs of that job.

The number of Platforming units now operating, and the acceptance accorded Platformed gasoline at the point-of-sale is certainly convincing proof of Platforming's success in doing the job for which the process is intended.

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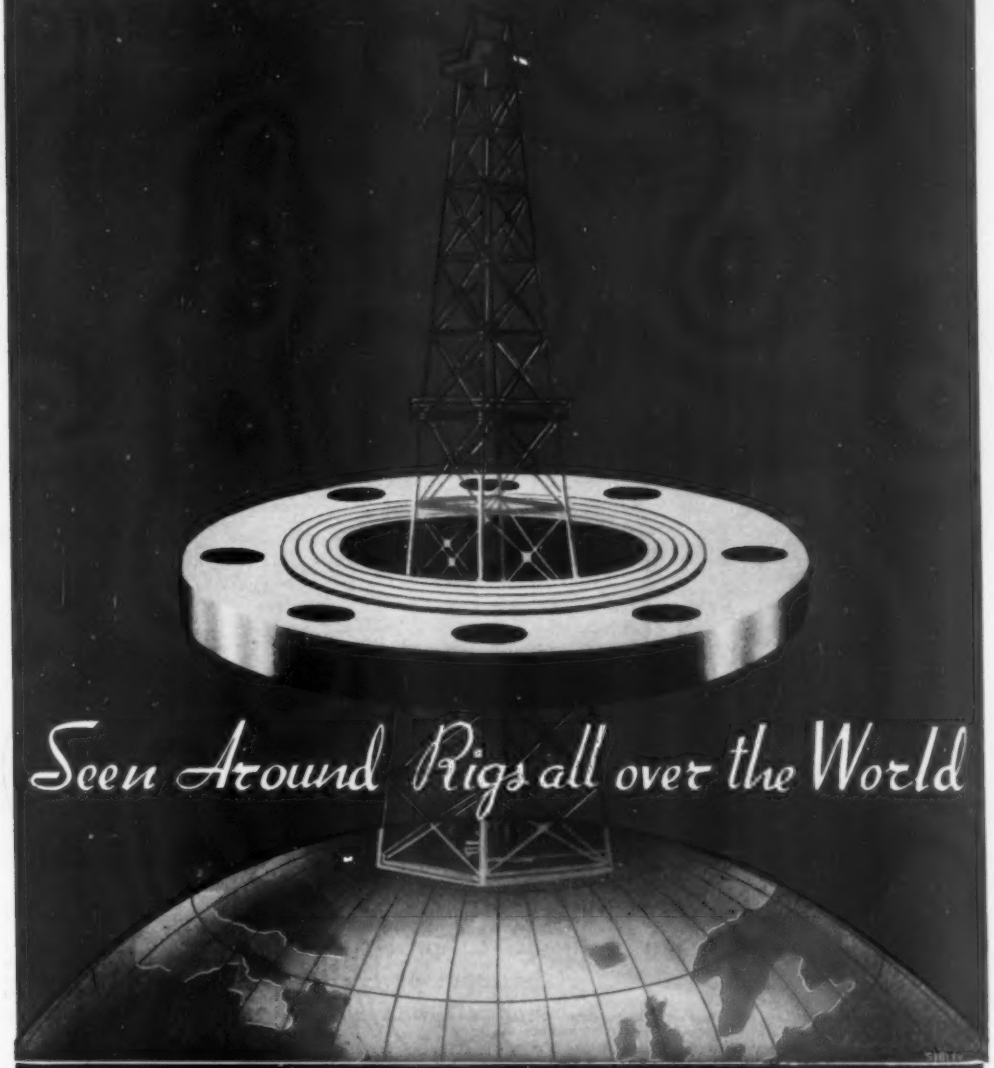
Universal Service Protects Your Refinery

BURTON DELINGPOLE FLANGES



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TELEPHONE : CRADLEY HEATH 6237-8 TELEGRAMS : STAMPINGS, CRADLEY HEATH

THIS is the answer to OIL FIRE PROBLEMS

The Avonmouth Oil Fire — and the completion of new Refineries—has kept the subject of Oil Fire Dangers in the news for several months. It is fitting, therefore, to bring to the notice of all those concerned the latest means of overcoming bulk oil fire risks.

The method shown here, which has already been installed at a number of Refineries, is the quickest and most practical for the purpose of delivering Foam to Refinery Plant or Oil Tanks in the event of fire. The provision of a "PYRENE" Refinery Foam Tender makes it possible to convey to the scene of the outbreak the required foam compound, foam generating equipment, pump and all fittings for coupling up to the Hydrants or Static Water Tanks and Foam Risers on the tanks. With this fire-fighting vehicle the finest mechanical foam can be delivered on to the surface of the blazing oil without necessitating long runs of pipelnes.

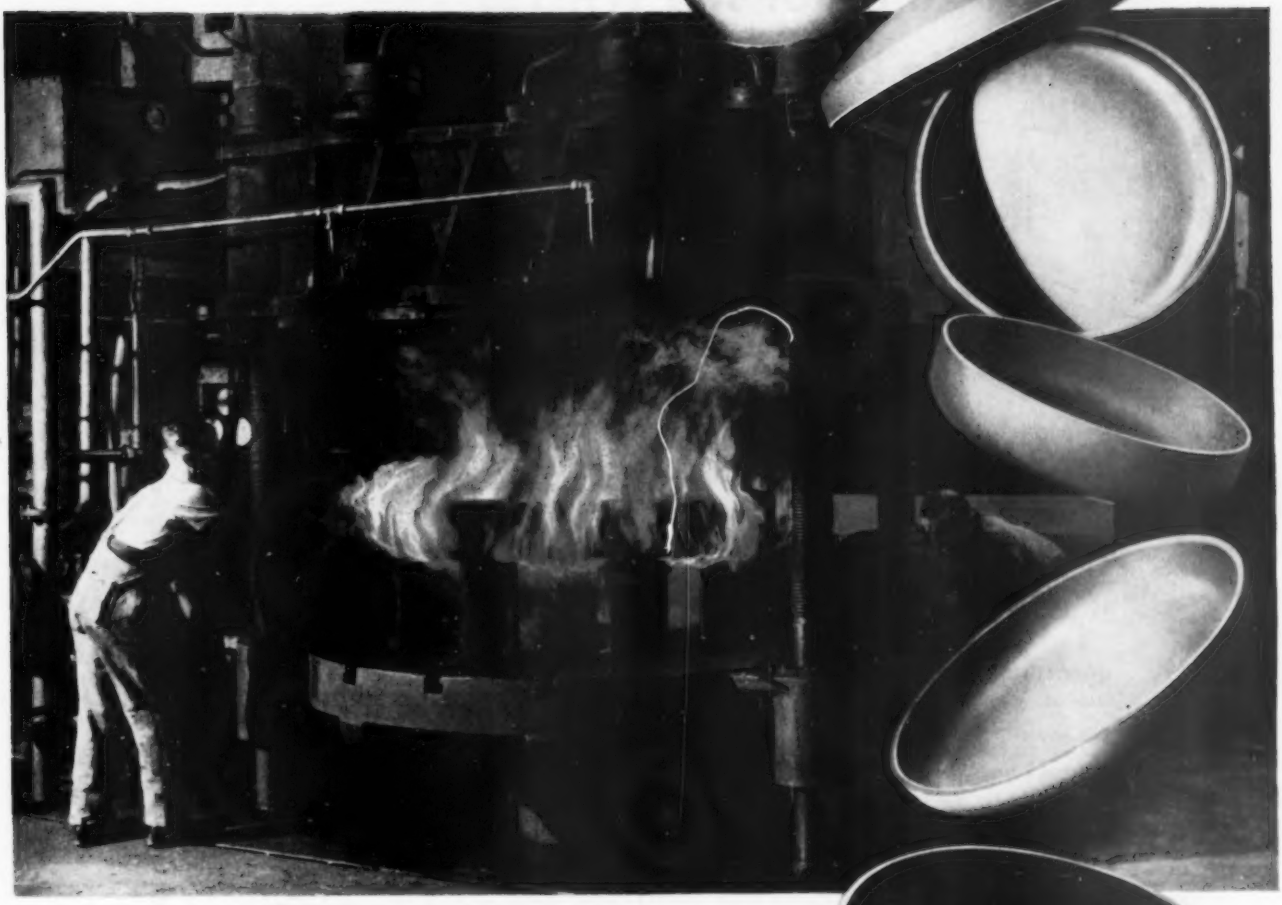
This particular "PYRENE" Refinery Foam Tender carries 600 imperial gallons of "PYRENE" Foam Compound. Two No. 20 and one No. 10 "PYRENE" Mechanical Foam Generators and four F.B. 10 Portable Foam Branch-pipes. It is capable of producing 4,500 imperial gallons of Foam per minute for 30 minutes without replenishment.

Full details of this and other modern methods of extinguishing Oil and Spirit Fires will be forwarded without obligation. Please send your enquiry to Dept. W.P.3.

Pyrene TRADE MARK
FIRE FIGHTING EQUIPMENT

THE PYRENE COMPANY LTD., 9, Grosvenor Gardens, London, S.W.1.
Head Office and Works: Great West Road, Brentford, Middlesex.
Associated with:— Pyrene Manufacturing Company, Newark, New Jersey, U.S.A. and Pyrene Manufacturing Company of Canada, Limited, Toronto, Ontario, Canada.

DISHED ENDS ?



OUT of the furnace and into the press goes the partially finished end . . . up comes the powerful press ring to form the required flange . . . and another Dished and Flanged End is ready.

Furnace and press capacity is available at Harvey's Greenwich works for the pressing of both light and heavy Dished and Flanged Ends. Diameters range from 6" to 9' 0", edges can be prepared for either welding or riveting. For details and tables showing dimensions available, send for List WP 790

Harvey

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THERE IS NO guessing about truck quality on the extra-heavy hauling jobs.

You know!

And you know about White Quality. Frames, for example, on the sturdy White six-wheelers for off-the-road service, not only carry the giant loads, they take all kinds of abuse, withstand greater shocks and strains loading and unloading.

There's a reason, of course, that shows up first day on the job and year after year in hardest service.

White has a world-wide reputation which has extended over the years for quality—in the materials used for White Trucks . . . in the engineering . . . in the craftsmanship . . . and in White service for the life of the truck.

That's why you see so many Whites on all kinds of big hauling jobs . . . in all parts of the world. Find out how White Quality can add efficiency and economy to your transportation requirements.

Check THESE WHITE ADVANTAGES

√ **WIDE RANGE** of models to meet every extra-heavy hauling requirement.

√ **TANDEM** drive units with double reduction axles.

√ **DOUBLE CHANNEL** heat treated frame. Full range of wheelbases.

√ **ENGINES**—gasoline or diesel.

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√ **BODIES**—oil-field bodies and winches available. Other equipment for special requirements available also.

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Another LEADER by Security

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THE SECURITY REAMER-ROCK BIT

- **FOR TOP HOLE DRILLING**
- **ONE TOOL DOES TWO JOBS**

Security Reamer-Rock Bits lead the field because they always drill clean full-gage holes, free of steps and ledges.

The rugged one-piece body construction combines the fast action of the Security Rock Bit with the perfect stabilizing action of the Security Reamer. Bit life is increased as much as 100% by elimination of bit gyration and walking — and the hole is left in perfect condition for setting pipe.

The Security Reamer-Rock Bit is the best possible assurance in starting your hole right.

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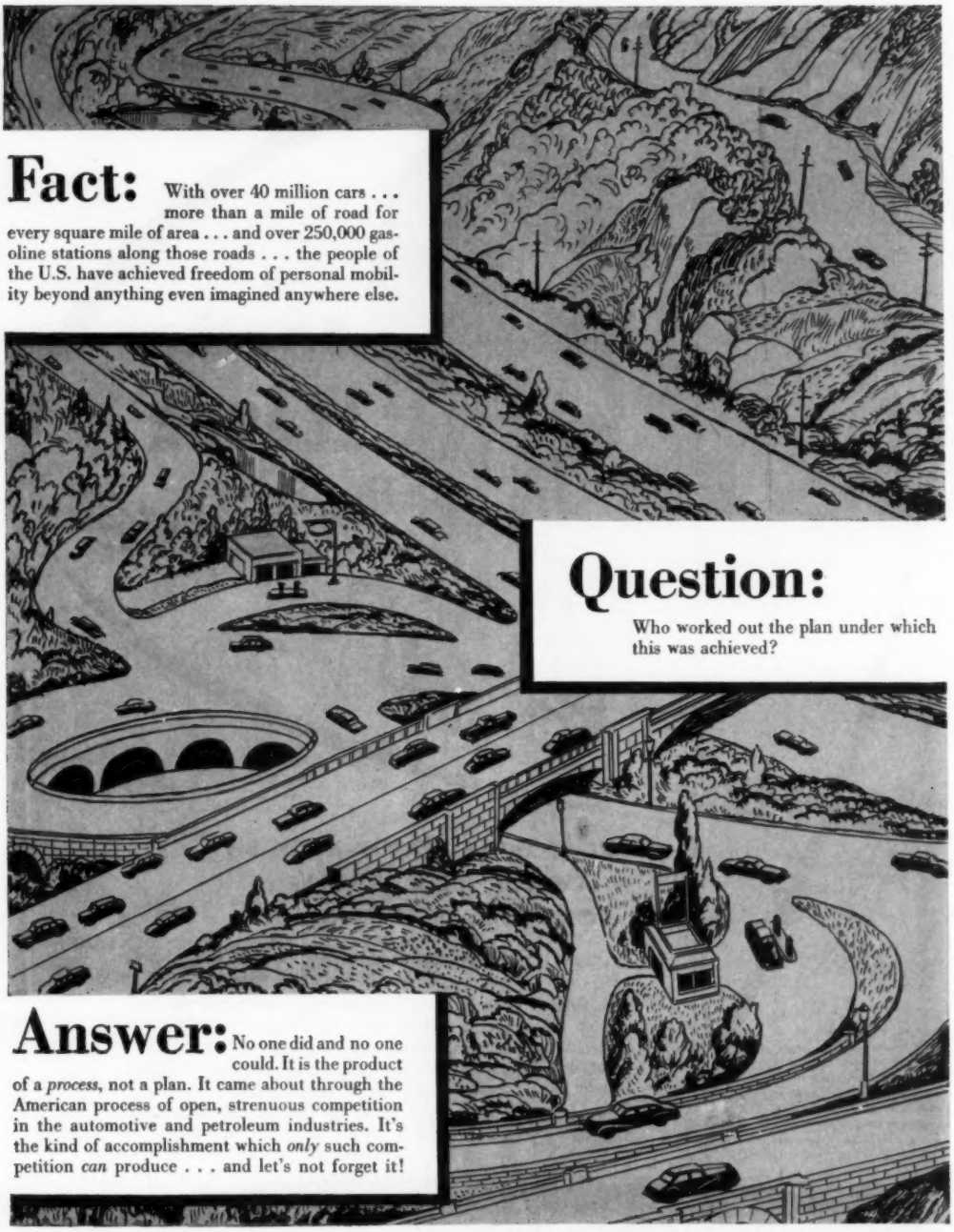

Fact: With over 40 million cars . . . more than a mile of road for every square mile of area . . . and over 250,000 gasoline stations along those roads . . . the people of the U.S. have achieved freedom of personal mobility beyond anything even imagined anywhere else.

Question:

Who worked out the plan under which this was achieved?

Answer: No one did and no one could. It is the product of a *process*, not a plan. It came about through the American process of open, strenuous competition in the automotive and petroleum industries. It's the kind of accomplishment which *only* such competition *can* produce . . . and let's not forget it!

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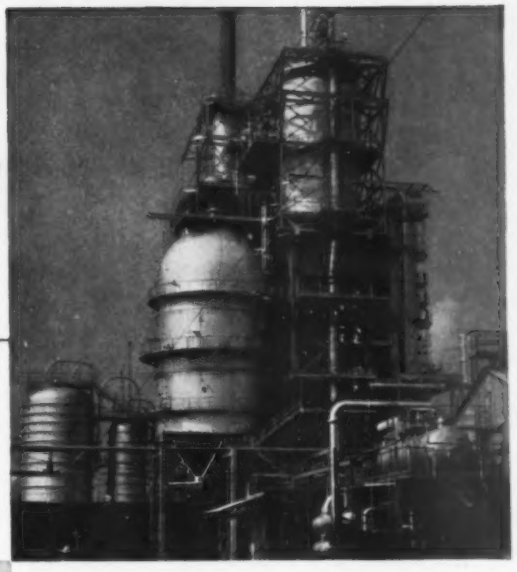
The competitive system delivers the most to the greatest number of people

Cat-Lube* does double duty for Sohio



Sohio's continuous contact filtration and catalytic cracking units

The Sohio lube finishing unit represents the most advanced engineering concept for the continuous contact filtration process. In this plant, operating and maintenance costs are reduced and capital investment was lowered as compared to earlier installations.

Fluidized handling of the adsorbent permits a dust-free operation and hence a marked improvement in unit housekeeping. These are obvious important advantages but Sohio has added to them equally important economies through the use of Filtrol's Cat-Lube (Adsorbent Catalyst).

FILTROL DOUBLE-DUTY CAT-LUBE IMPROVES MAJOR OPERATING ECONOMIES

Filtrol Cat-Lube at Sohio's Lima plant does double duty. After bringing the finished oil to high specifications demanded of the decolorizing step at the lube plant, the spent adsorbent filter cake is slurried with fresh cat cracker feed and pumped to the fluid catalyst cracking unit. Although this unit is not equipped with a precipitator, activity maintenance is good and the "cat cracker" has continued to show a high level of performance.

Write for full information on Cat-Lube

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AS A RESULT of broad experience in the organic and inorganic chemical field, the Badger Process Division of Stone & Webster Engineering Corporation has made and is making significant contributions in the large scale production of life-saving pharmaceuticals.

Working currently for Commercial Solvents Corporation and General Aniline & Film Corporation, we are helping make it possible for these clients to produce in quantity synthetic expanders for blood plasma. These products do not take the place of blood plasma, but save lives by temporarily sustaining shock victims until they reach a hospital where the blood plasma is available.

STONE & WEBSTER ENGINEERING CORPORATION

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Seismic instrumentation starts with the geophone. SSC's geophone is a result of years of practical field experience coordinated with laboratory research and design.

This geophone which is adapted to the conditions of the area is the first unit in the series of instruments providing geophysicists with seismic data of the highest quality.

SSC is constantly striving to provide a more effective seismic exploration service for the petroleum industry.

Seismograph Service Corporation

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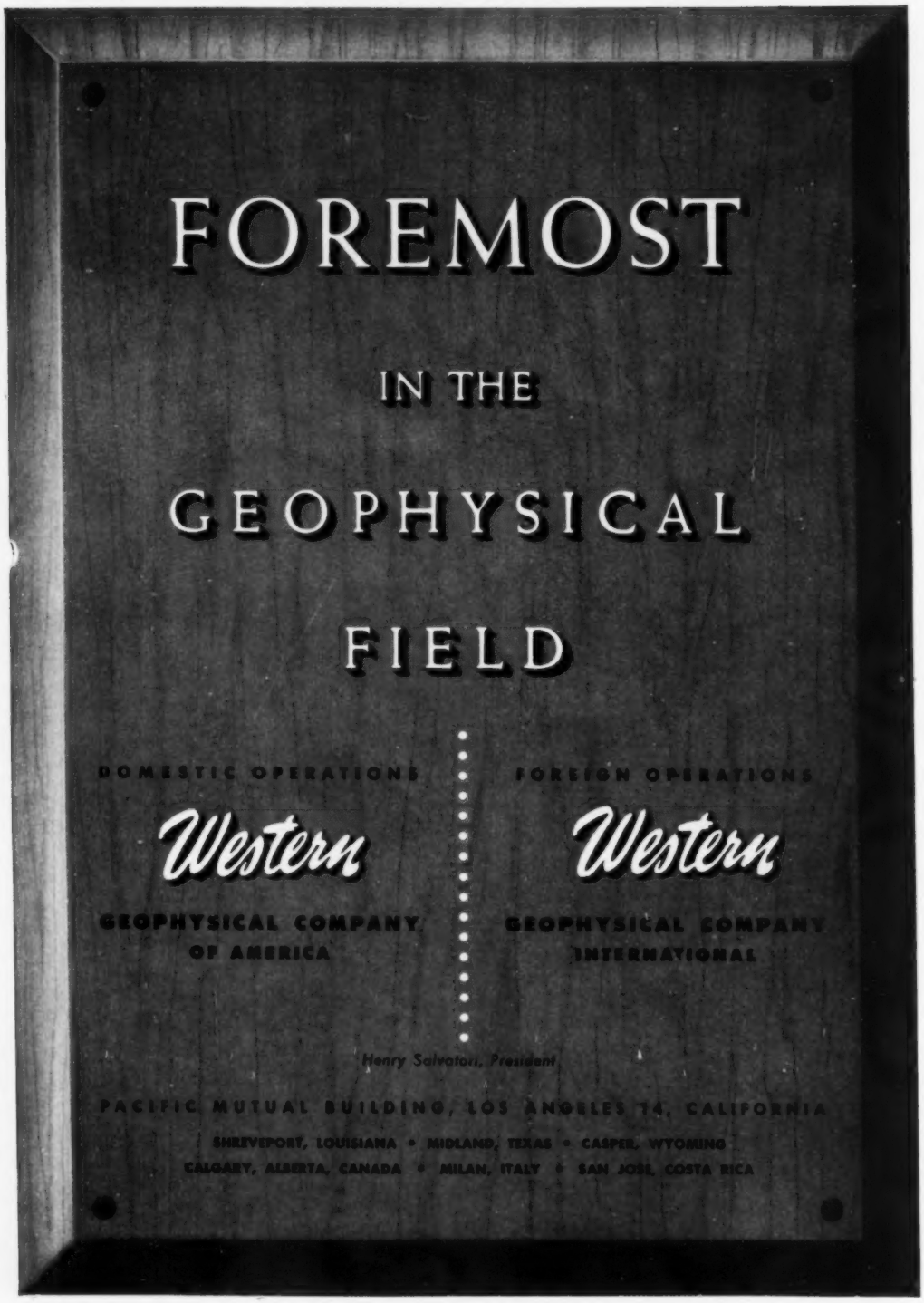
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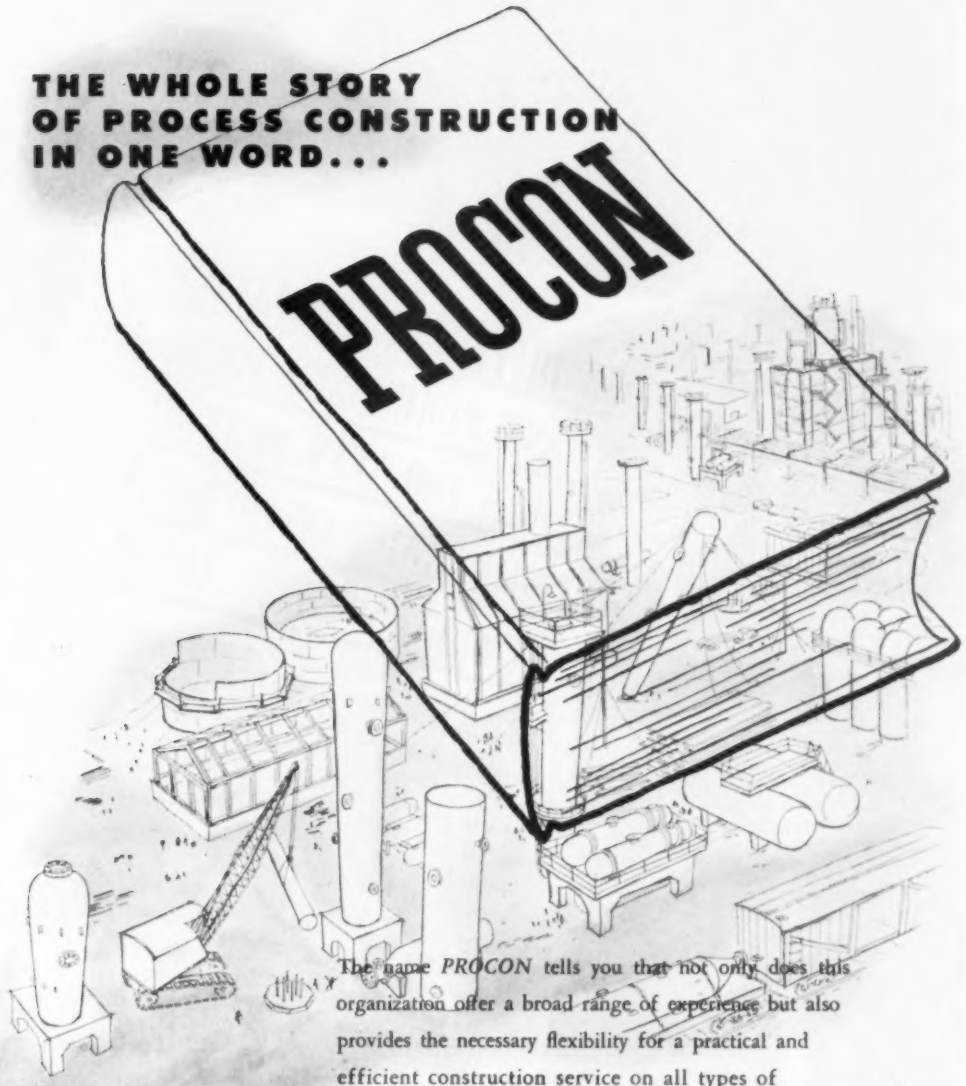
THE WHOLE STORY OF PROCESS CONSTRUCTION IN ONE WORD...



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Your business is finding oil. Our business is instrumentation. It is up to us to provide you with the best instruments money can buy. Therefore our entire efforts and facilities are concentrated on the necessary RESEARCH, PRODUCTION DESIGN, MANUFACTURING TECHNIQUES and SERVICE PROGRAM to supply you with fine Seismograph Instruments and associated equipment.
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US 36

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Rheemcote shipping containers are also **selling containers!** Beautifully lithographed in any colors, any design, they promote your product and name wherever they go. Use this powerful new advertising medium.

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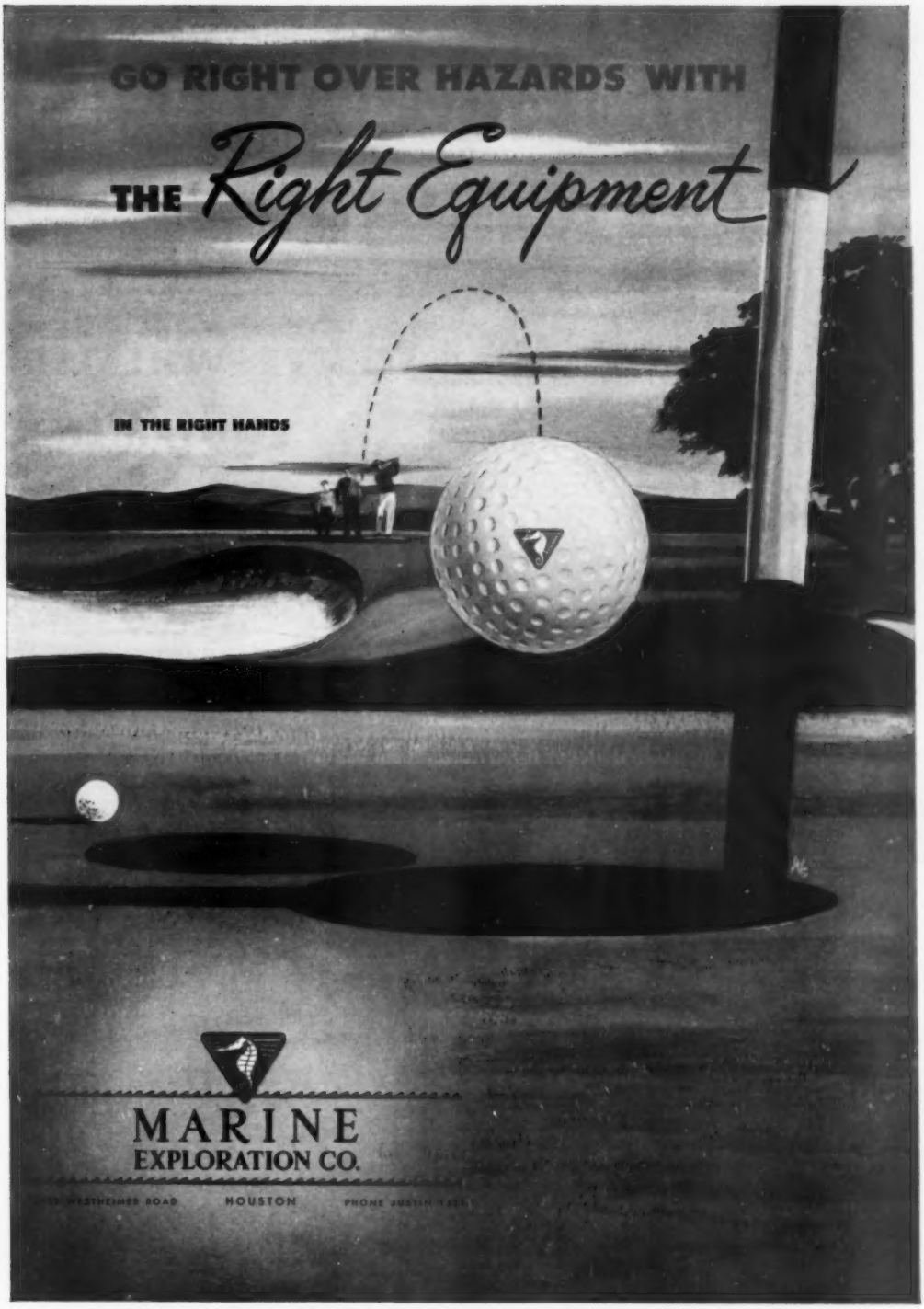
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THE Right Equipment
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by-product with a big dividend

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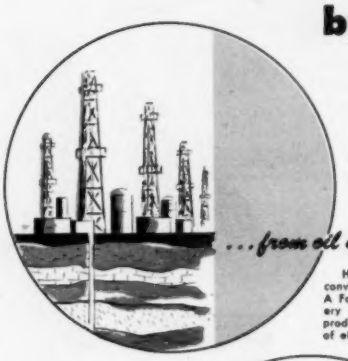
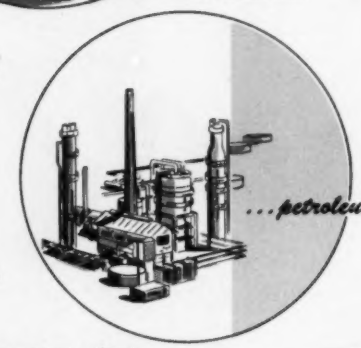


...from oil and gas fields

H_2S content of sour gas converted to elemental sulfur. A Foster Wheeler sulfur recovery plant in one location is producing over 300 tons/day of elemental sulfur.

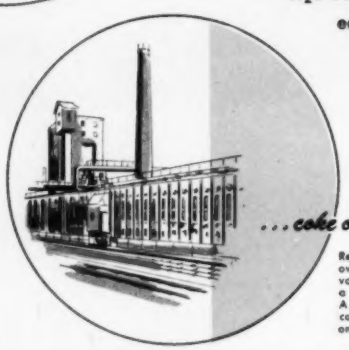


...petroleum refineries

H_2S gases previously "flared" and the sulfur wasted, now recovered. Two Foster Wheeler sulfur recovery plants for this service now under construction.

The unprecedented demand for Sulfur has reached a point where the world's available supply is seriously threatened. Thus, the need to find new sources for this vital element becomes one of the major items on today's agenda for full-scale production for both defense and civilian needs.

Fortunately, there is a great new source. Instead of allowing it to vanish into thin air, Sulfur is being recovered profitably from H_2S bearing gases with Foster Wheeler equipment. A quarter million tons of Sulfur per year will be recovered by Foster Wheeler plants installed or now under construction.



...coke ovens

Removal of H_2S from coke oven gas not only enhances the value of the gas but provides a source of elemental sulfur. A Foster Wheeler sulfur recovery plant is in operation on this service.

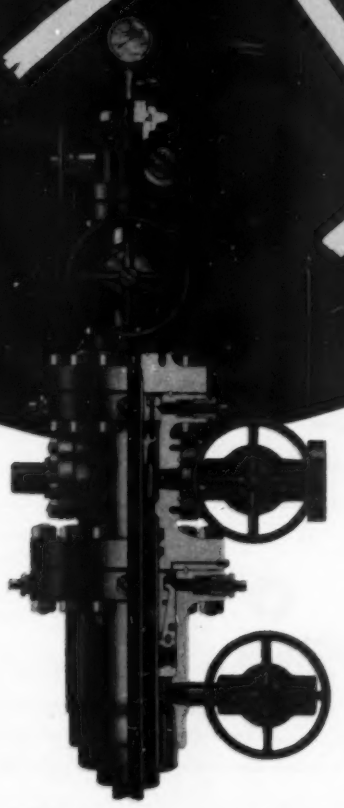
FOSTER WHEELER

165 BROADWAY, NEW YORK 6, N. Y.

You'll always win . . .

WITH THIS LINE-UP!

O C T



WHETHER YOU BUY WITH DOLLARS OR POUNDS STERLING

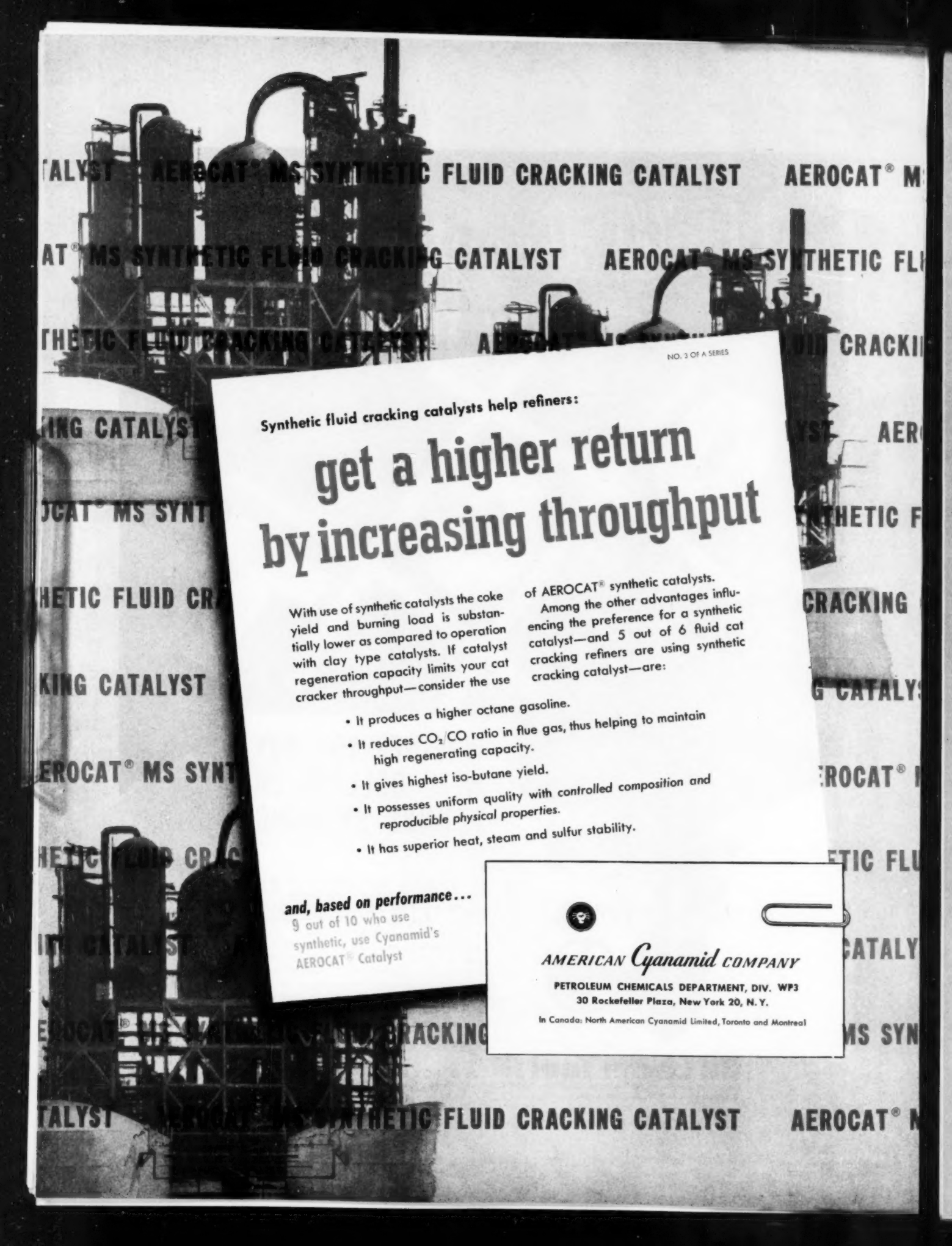
From top to bottom, this assembly consists of an O-C-T "JE-1" Flow Control, B-2 Bonnet, WA-4 Tubing Hanger, T-16 OU Tubing Head and the C-19 Casing Head. Yes, it's O-C-T quality from top to bottom . . . labeled by many as the oil industry's most practical wellhead assembly.

In pound-sterling areas O-C-T equipment is available from LeGrand, Sutcliff & Gell, Ltd., and in the United States from Oil Center Tool Company or your nearest supply store.

Write today for complete information on Oil Center Tool Company wellhead equipment. We will be glad to give you details on the O-C-T policy that makes dependable equipment immediately available to you in your exchange.

Oil Center Tool Co. P. O. BOX 3091 • HOUSTON, TEXAS

Export Representatives: Sterling Areas — Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for All Other Countries to P .O. Box 3091, Houston 1, Texas.



NO. 3 OF A SERIES

Synthetic fluid cracking catalysts help refiners:

get a higher return by increasing throughput

With use of synthetic catalysts the coke yield and burning load is substantially lower as compared to operation with clay type catalysts. If catalyst regeneration capacity limits your cat cracker throughput—consider the use of AEROCAT® synthetic catalysts.

Among the other advantages influencing the preference for a synthetic catalyst—and 5 out of 6 fluid cat cracking refiners are using synthetic cracking catalyst—are:

- It produces a higher octane gasoline.
- It reduces CO_2/CO ratio in flue gas, thus helping to maintain high regenerating capacity.
- It gives highest iso-butane yield.
- It possesses uniform quality with controlled composition and reproducible physical properties.
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CONTENTS

43 Team Work on a Prodigious Task
44 Some Aspects of Seismic Surveying
48 Oil Exploration in North Africa
52 Cuba a Challenge to Wildcatters
56 Gas Turbine Powered Tanker Completes First Voyage
58 Power Rig Hoists
63 The Controversial Spraberry
66 Observation of Seismic Echoes
70 Venezuela's Oil Economy Linked with United States
77 Denver-Julesburg Basin
84 $10,500 Million Expansion Program for Oil Industry Mapped by PAD
86 British Oil News
90 International News & Notes
96 Oil Company Staff Changes
116 Advertiser's Index

THIS MONTH'S COVER

Piecing together a mosaic map. Sections are minutely proportioned to give an exact picture of the entire region and subsequently rephotographed for geological studies. Color photograph by Ed Asmussen for the Standard Oil Co. of California reproduced through the courtesy of the editors of the Standard Oil *Bulletin*.

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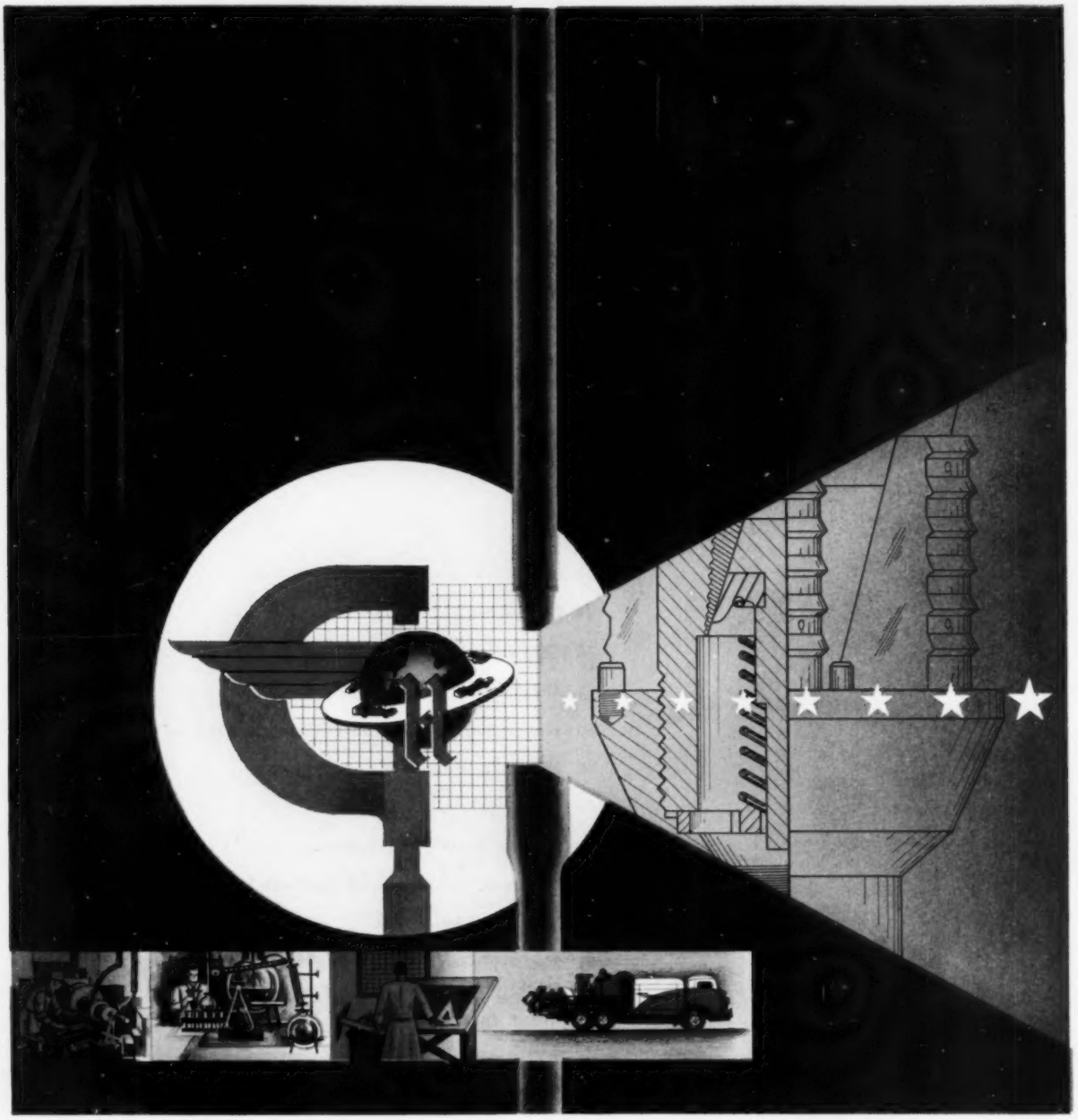

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Editorial

Team Work on a Prodigious Task

THE AVERAGE consumer of petroleum products is not astonished that there is always fuel oil in his tank and that the service station pumps never run dry. He takes it as a matter of course as he does the switch which floods his room with electric light, the water tap which gushes at his touch. Producers of petroleum, on the contrary, never cease to be amazed that they are able to keep the pipe lines full and retain a backlog of reserves in the face of a demand which nearly doubles in size every ten years. In 1900 world production was 150 million barrels; in 1910, 328 million; 1920, 690 million; 1930, 1,400 million; 1940, 2,150 million; and in 1950 the total was 3,795 million barrels. This year the demand will exceed 4,500 million barrels.

While keeping pace with the rocketing demand, producers have blocked out larger and larger reserves, maintaining the recoverable future supply at something like a 20-year level (at current, not future rates). Today we appear to have about 90,000 million barrels of oil in sight. Five years ago the known reserves was perhaps 60,000 million barrels.

This magnificent record of accomplishment is the result of unremitting study and work on the part of a complex team. How otherwise could the success ratio in wildcat wells remain almost constant at one out of eight in regions which have been prospected over and over again?

In the field of geological and geophysical reconnaissance, manufacturers have vastly improved the delicate scientific equipment needed to measure sub-surface characteristics of the earth. At the same time, technicians are enhancing their skill in eliminating variables in the field and in interpreting results in the office.

New methods have come into being and still other techniques of detecting anomalies may yet prove useful. Take, for example, the recent suggestion that the high-sensitivity gamma ray detector known as a scintillation counter may be employed like the magnetometer in planes to survey quickly large areas for prospective drill sites. The new instrument developed at the University of Manitoba is 150 times as sensitive to gamma rays as the geiger counter, and this opens an entirely new realm for investigation.

An important member of the team is the petroleum engineer who has made such tremendous strides in the recovery of greater proportions of oil from previously discovered reservoirs. An outstanding example of this type of work is the Spraberry region in West Texas which to many seemed hopeless as a big producer when discovered three years ago. Now, after intensive study, it is producing two million barrels of oil monthly from a thousand wells. Pessimistic early estimates of per acre recoveries are being raised month by month.

Not to be overlooked is the equipment engineer who is devising better tools for drilling and producing oil. He must be credited with keeping the cost of finding and lifting oil low in comparison with general inflationary tendencies.

With the aid of the exploration technician and the production and equipment engineer, oil management people have expanded operations in line with demand in every region of the world where investors have a chance for a fair return on their risk capital. In regions where a fair return is not possible, the industry cannot flourish. This involves encouragement to wildcatters such as the tax allowance for depletion in the United States. In other countries where mineral resources are owned by the State, it is essential that risk capital have security of tenure in its concessions and a fair share of the profits resulting from operations.

An "earthquake" in the swampy Gulf coastal region.

SOME ASPECTS OF SEISMIC SURVEYING

By B. B. Weatherby

Vice President, Amerada Petroleum Company

This article is based upon and reproduces in part an address delivered before the Society of Exploration Geophysicists by Dr. Weatherby at Dallas, Texas, November 19, 1951.

IN ITS broadest aspect, the problem before geophysicists of the United States is to keep the country supplied with the necessary oil and gas. This is a problem of immense proportions. In 1950, for the first time, over one half (54 percent) of the energy requirements of our dynamic economy were supplied by oil and gas. Recent daily crude oil production rates indicate that more than two billion barrels will be produced in 1952. While the size of the national debt and the annual tax bill, as well as frequent news releases from Washington, should have accustomed us to deal in billions, it is still difficult to comprehend such astronomical figures, so an example or two may serve to show how much oil we are using and how much we must find if we are not to fall in arrears.

Western Canada, particularly Alberta, came into the limelight a few years ago because of the discovery of the two large reef oil fields at Redwater and Leduc. More recently a number of smaller fields have been found there as the result of an aggressive exploratory campaign. In spite of the large size of Alberta's known reserves, they add up to about the same as the amount of oil consumed in the United States every six months.

The huge East Texas field, by far the largest fund in the United States to date, except perhaps for the comparatively new Spraberry accumulation in West Texas, has produced in over 20 years about the same amount of oil as is needed in a little over a year at our present rate of consumption.

The problem of finding two billion barrels of oil a year is a hard one to solve, since it occurs at a time when oil is becoming increasingly difficult to find. The difficulty is further aggravated by the fact that even greater amounts may be needed in the future. It was stated at the recent API meeting in Chicago that world production rates in the next ten years probably will need to be some 35 percent larger. The United States has been producing nearly two-thirds of the world's oil from one-third of the world's petroleum reserves. In mid-1950 its excess efficient productive capacity was approximately one million barrels per day, but this has dwindled to about one half this amount at the present time. Furthermore, the state of international affairs may make it necessary to increase producing capacity beyond the figures previously mentioned. There can be no doubt of the immensity of our problem and of its increasing complexity.

In his annual review of wildcat drilling, Dr. Lahee has told us that of some 5,000 wildcats drilled in 1950 on technical information only one out of eight was successful. Even a rookie in the big leagues would need a better batting aver-

age than this to stay on the payroll. Our low batting average is an index of the difficulty of finding oil and at the same time is a measure of the opportunity for improvement. The small size of the accumulations in many of these discoveries has also been emphasized. This suggests that one approach to our problem would be to allocate a larger percentage of our exploratory activity to those areas where the density of geophysical coverage and the density of wells is sufficiently low to give a better chance for the discovery of oil fields of substantial proportions.

In the past few years there have been times when there were from 80 to 100 crews in the coastal areas of Texas and Louisiana. There were also a considerable number in both the San Joaquin Valley of California and central Oklahoma. These crews were working in counties, parishes and townships in which there had been sufficient previous shooting to cover the areas thoroughly from 20 to 50 times. It is these programs of some years ago that are responsible for the present day discoveries, since an average lag of some three years exists between the initiation of an exploratory campaign and the discovery of oil as a result of it. In addition to the heavy seismic coverage there was a sufficient density of wells in a good part of these areas virtually to preclude the existence of any very substantial field.

If the emphasis is to be placed on larger discoveries it will be necessary to curtail activities in these densely drilled areas, and to move out to the more hazardous but potentially more profitable provinces which are relatively undeveloped. The February 1951 Bulletin of the American Association of Petroleum Geologists listed a substantial number of areas with thick sedimentary columns of marine origin where little prospecting had been carried on. These more or less attractive areas extend from the Florida peninsula on the southeast to Nevada and even Washington on the northwest. Recent developments in the Williston Basin suggest that a new petroliferous province has been found as a result of prospecting in such areas. In addition there are a substantial number of relatively small intermontane basins or valleys which have petroliferous possibilities but which have seen little or no exploratory activity. Prospecting in the Cuyama Valley of California resulted in a substantial discovery not too long ago.

However, re-allocation of crews is not the only approach to the solution of our problem. Another line of attack would be the application of a new prospecting tool, but as far as I know there is no new method that has demonstrated its ability to make significant contributions to our reserves. The approach to this problem that I wish to stress is the more efficient use of existing seismic methods and crews. A considerable part of our exploratory program is being conducted in an intelligent, business-like, and efficient manner by competent and serious-minded men. Nevertheless, considerable improvement in efficiency can be achieved by careful attention to certain points.

Some surprising differences have been observed in the quantity, quality and unit costs of work performed by different crews in exactly the same area, and when the time of year and weather conditions were essentially the same. In one area it cost $1,120 to shoot a mile of line. The cost with the second crew was reduced to $650 per mile. Moreover, the less efficient of the two crews had only 60 percent as many good or fair profiles. In another area the cost per profile of the first crew was $129 while that of the second was $88. Again the less efficient crew had much inferior data, obtaining only one quarter as many good or fair profiles. In this case the difference in reflection quality was so great that the work of the poorer crew had to be repeated to make a dependable map.

Differences in instruments, differences in instrument operating practice, and variations in field procedure are factors which will influence these indices directly. But the effectiveness of a particular seismic program also depends upon its relationship to its geological setting, on the interpretation of the seismic data, and the integration of the data with other geological information before the final evaluation is made.

Over the years seismic instruments have been developed to a high degree of perfection. Their stability is so great that they can withstand continuous mechanical shocks. They can operate under wide variations in temperature and humidity. They have quite flexible electrical characteristics which can be adjusted to meet greatly variable field conditions. Automatic volume controls keep the amplitude of the traces on the record within bounds. The effect of these marked improvements in instruments has been to permit exploration to spread to areas which are in-

Lowering a charge into a shot-hole near Huntsville, Texas. Photo by Bubley for Standard Oil Co. (N.J.)

Gravity meter in the Mackenzie River area of the Northwest Territory of Canada employed as part of the geophysical survey program. Photo by Collier for Standard Oil Co. (N.J.)

creasingly more difficult to work and in which only a few years ago it was not possible to do a satisfactory job. However, there are still some of the other instruments in use which could be retired at the earliest possible moment, especially if one of the more difficult areas is involved.

Unfortunately, the advanced state of instrumentation has not reduced the requirement for skilled operators. Since more variables are under his control, more skill is necessary in their manipulations if the best possible record is to be obtained at each location. Perhaps one of these days the user of a set of seismic instruments will need to know no more about the theory and operation of his instruments than does a paleontologist about the theory of optics, and perhaps the taking of a seismic record will be as simple an operation as bringing a heterostegina bug into focus in a microscope. Until such time, the men who are responsible for the operations of the instruments should have considerable training and experience if they are to obtain the best results of which the instruments are capable. It is a little difficult to understand why four years are necessary to train a man to be a machinist when frequently a seismic operator is supposed to be made in a year or so. Perhaps mental agility can be acquired more rapidly than manual dexterity.

The recording of time breaks, up-hole times, and first breaks should approach the mechanical perfection of focusing a microscope, and although the recording of these events is generally satisfactory, there is still room for improvement.

The invention of the automatic volume control was at first blush a great boon to the operator. By its use the number of shots necessary to cover the desired range of reflection depths was greatly reduced. It is a rather common practice for the operator to shoot a sufficiently high charge to cover the entire depth range with one shot. Unfortunately, in so doing it frequently happens that little attention is paid to the depth to basement and the charges generally used are much larger than necessary to reach the maximum depth of interest. Quite aside from the cost, which is not inconsiderable, this over-charging imposes a severe strain on the ability of the AVC to hold amplitudes within bounds in the early part of the record and may well lead to distortion of shallow reflections. An appreciable part of one prospect was covered with charges of from 15 to 20 pounds before a field check indicated that two pounds gave adequate amplitude to the depth of granite.

Suppression was adopted when the amplitude variations in the early part of the record were too great for the automatic volume control to handle. It must, however, be used with discretion, otherwise the magnitude of the first breaks may be reduced to the point where they are undependable for weathering calculations. Because suppression obscures the amount of ground unrest and instrument noise at the time of the shot, there have been cases where unsuspected unsteadiness has badly interfered with the key reflection, and other cases where the overall sensitivity was so badly distorted by the combination of suppressor and volume control that the outstanding reflection was lower in amplitude than those on either side of it.

Choice of filter settings is now within the discretion of operating personnel. Some operators favor broad band pass characteristics, others a narrow band pass which may be peaked either low or high. Although it is logical to expect that these characteristics will be chosen so as to favor the key reflection in a particular area, this has not always been the case.

Most of the mistakes made with regard to instruments and their operation could have been corrected before they reached substantial proportions by a careful and regular check of the instruments, made by an operator with sufficient knowledge of their action to be able to spot and correct difficulties as soon as they developed.

After examining the "modus operandi" in a large number of areas, it has been observed that there is a striking uniformity in field procedure, regardless of very substantial differences in field and geological conditions. This leads to the conclusion that there is too much standardization of field operations. Furthermore, considerable resistance from operating personnel has been met when efforts were made to adapt the program to conditions in the area. While much can be said for making field operations as routine as possible in order to increase output, it should not be carried to the extreme of interfering appreciably with record quality. This lack of flexibility has caused continuous profiling to be used in areas of excellent reflection quality where spot correlations could have covered the area much more cheaply and with a more uniform density of data. Even in areas where shot holes are expensive and will stand up to repeated shots and where the reflections are not impaired by the wider angles, straddle or split spreads are used, whereas if the full spread was shot from each end, the number of holes needed would be approximately halved. Again, there are some areas where hole noises seriously interfere with the near vertical reflections, and others where the reflection quality is appreciably better at the wider angles. In such areas the spread should be moved from its close proximity to the shot point.

So much for instruments and field procedure. Let us now turn to those factors which have a less direct influence on performance indices but which are very important in determining the effectiveness

Lowering explosive into an 80-foot offshore shot-hole in the Gulf of Mexico. Shell Oil Co. photo.

of a seismic program. The interpretation of the seismic data is the first of these.

Spot correlations occasionally have resulted in the miscorrelation of so-called reflection character. This has been largely eliminated by continuous profiling. With the use of this latter method care must be exercised not to push the reflection "picks" too far in an effort to establish a non-existent continuity. If the reflection amplitude virtually disappears on a given record, then continuity may disappear too, and the picking of very low amplitudes will only indicate a false continuity on the cross sections which can well lead to erroneous conclusions concerning the geological structure. Where the data are discontinuous and made up of a series of reflections from a zone rather than from a single reflecting horizon, the dip of the beds in that zone is generally shown on the cross section as a so-called phantom horizon. The dip on this phantom horizon should be of the same magnitude as the dip shown by the separate dip segments and neither increased nor decreased at the whim of the interpreter. If the time ties from profile to profile are in error by more than two or three-thousandths of a second, then every effort should be made to find out the reason and correct it. If these differences accumulate around a traverse rather than cancel, they may lead to an erroneous interpretation of the structure. Though attention may be focused on a particular reflecting horizon or horizons in a given area, there is likely

Seismograph record under inspection on an instrument boat operating in the Gulf of Mexico. Shell Oil Co. photo.

to be considerable additional information on the record, all of which should be utilized to the extent perhaps of making several different isopach maps. Even in areas where the shallow horizons are supposed to have no particular geological significance, they may still give indications of structure which may later turn out to be of great value. For example, a number of West Texas reefs have apparent uplifts in the beds above the reefs.

In shooting over certain faults which are known from well data, some unusual events have been observed on the records. These events suggest that occasionally the fault plane itself acts as a reflector and in other cases that some part of the path of the reflected wave has been along the fault plane. On the one hand these unusual events offer the possibility of recognizing faulting although their correct interpretation may not be easy, while on the other hand the interpretation of the structure adjacent to the fault may be erroneous if the relationship of such events to faults is not recognized.

Substantial changes in velocity sometimes occur in short distances and the geophysical maps should be periodically reviewed and perhaps corrected as this information becomes available. Whether a seismic map is expressed in depths or time, it is implicit in the geological interpretation that the velocity from point to point is either constant or varying according to some assumed rate. An unexpected change in velocity caused an error of 620 feet in the depth difference between two points six miles apart on a Pennsylvanian horizon in West Texas. Every wildcat well gives valuable information, not only on the depths to the different horizons, but also on the stratigraphy and lithology. A restudy of the geophysical maps in the area around each well may lead to important conclusions.

Much has been said about the relation between geology and geophysics, and much probably needs to be said in an effort to increase the effectiveness of exploration campaigns. I would like to call attention here only to the relation of surface geology to seismic programs.

A great deal of oil has been found by drilling on surface and near surface structures, and this method of prospecting has been rejuvenated by photogeology with some success. As might be expected, some dry holes have been drilled in recent years on Tertiary surface structures in the Rocky Mountain area. Subsequent to drilling the dry hole some of these structures have been shot with the result that no structure was found at depth. This suggests of course that the shooting should have preceded the drilling of the well. There are some surface structures having beautiful exposures of rim rock that have developed into very substantial oil fields from drilling the surface closure. Examples of this type are Oregon Basin and Elk Basin. There are other surface structures that appear to be condemned by drilling. These should be carefully shot to see if the dry holes are on or near the top of deeper structure, for there may be considerable asymmetry and a very appreciable shift of structure with depth. Conversely, an absence of structure in these surface beds does not necessarily mean that there is no deeper structure below.

There are considerable areas overlain with badly crumpled and faulted surface beds which may or may not reflect the conditions of the deeper beds. At depth there may be a much simpler configuration of the strata, and consequently such areas are worthy of sufficient exploration to find out the true subsurface conditions.

Most of the weaknesses in instrument operation, field procedure, and handling of data are due to inadequately trained personnel. The shortage of trained man power may be explained by the fact that exploration has expanded more rapidly than men have been trained. When competent supervisors are prompt in correcting weaknesses that crop up in the field, when party chiefs and observers not only understand the operation of the instruments but also the way to use them to great advantage, when party chiefs and computers are interpreting seismic data accurately and thoroughly because they are aware of all the implications of the data, and when all of these men have been briefed on the geology of the area under investigation, then the general quality of seismic work will improve. Then we will be meeting the challenge of finding two billion barrels of oil a year most effectively and at the greatest profit to ourselves.

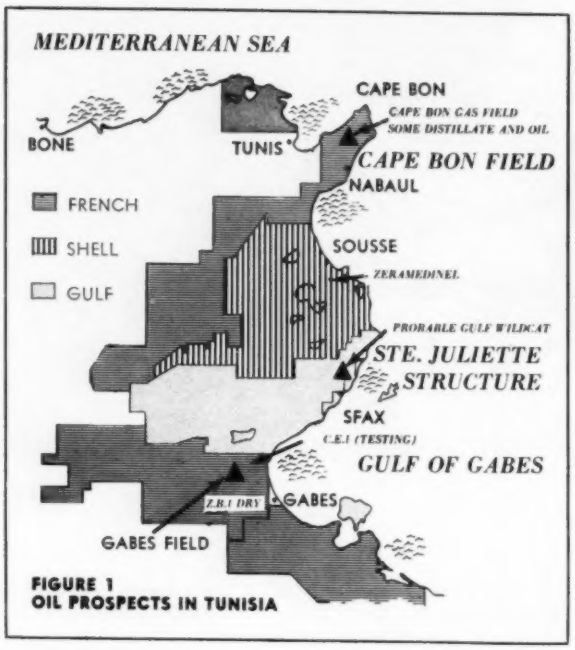


FIGURE 1
OIL PROSPECTS IN TUNISIA

OIL EXPLORATION IN NORTH AFRICA

SINCE the end of the war, oil exploration in French North Africa has been carried on at an increasing tempo. A geological map of the territory under consideration indicates in the region north of the African Shield a total of approximately 1,000,000 square miles of sedimentary basins. Some of them are very thick as is apparently the case with the eastern coast of Tunisia, where seismic work has revealed at least 10,000 feet of Tertiary soft formations, and in Algeria, where the drill has proved the existence of some 6,000 to 10,000 feet of Miocene on various structures in the Chelif Basin. In addition, large unknown basins probably exist in the south on the northern fringe of the Sahara desert. Structures are plentiful and the problem of systematic exploration is a tremendous task.

General geological considerations suggest that during the primary period, folding of Hercynian age occupied the present position of Tunisia, Algeria, and Morocco. It was limited to the north by a great geosyncline. During the secondary period this old mountain range which now constitutes the Meseta of Morocco and the high plateaus of Algeria was largely submerged by the sea and entirely cut off from the Sahara region. Liassic, Jurassic, and Cretaceous sediments were diposited and are now the material of the present deep subsidence basins of the Atlas regions.

At the end of the Cretaceous period the Riffain geosyncline deepened and the Cretaceous sea transgressed largely over all the Atlasic region.

During the Tertiary period, the Pyrenean folding gave to Moroccoan and Saharian Atlas their final structure with complete submersion. Later, during the Alpine time, violent folding occurred, creating the Rif in northern Morocco and the Algerian and Tunisian Atlas. The violence of the movement caused a number of Cretaceous folds transgressing during the Helvetian time. In Morocco, this transgression stopped between Casablanca and Oujda. In Algeria, it was followed by a Miocene transgression which fills up the numerous channels of the Mediterranean Atlas. Then the Miocene sea transgressed to the west of Algiers.

Finally, a Pliocene transgression invaded the coastal zone, but is only present today on the Mediterranean coast. The Rif became African during the sinking of the crystalline mass which occupied what is today the western Mediterranean. This sinking created the Strait of Gibraltar. During the quaternary, nothing worth mentioning took place.

An examination of the history of exploration in Tunisia reveals that before the war, a hole was drilled by American interests on the Cap Bon structure (See Figure 1) down to a depth of around 4,500 feet, but without success. In 1947 a French Company, the S.E.R.E.P.T., was organized. Between March 1948 and August 1949 it drilled a well fairly close to the original American hole, which reached a total depth of 11,000 feet in the Jurassic formation and was considered dry from 6,000 feet to total depth. However, a thin sand section had been revealed at a depth of 4,800 feet in the lower Cretaceous and a test by perforation was made. The well flowed 120,000 cubic meters of gas per day with 25 percent distillate. Two additional wells have been drilled since then: CB.2, a producer, and CB.3, a dry hole. CB.4, CB.5, CB.6, and CB.7 are presently drilling. Some oil has been found in one of the drilling wells.

SEREPT is also exploring in southern Tunisia, west of Gabes. A first hole ZB.1 was drilled on the Zemlet-el-Beida structure down to a depth of 9,883 feet. It is a dry hole. A second, CF.1, is being drilled on the Chett Fedjads structure. It found between 1,200 and 2,700 feet several thick fresh water sands with lots of good drinking water, a rare thing in southern Tunisia. It is now at a depth of 7,700 feet in Cretaceous limestone and has found some very interesting oil shows. Testing is in progress.

Very soon exploration in Tunisia will increase its pace. Shell is already drilling its first well and Gulf will start drilling this Spring. Under the decree of March 2, 1949, both have been granted concessions in Tunisia (See Figure 1). The terms of this decree provide for the following general conditions: 65 percent of the capital of each new company (C.P.D.T. and S.N.A.P.) belongs to Shell or Gulf; 35 percent is subscribed by SEREPT (the French company).

At present, Gulf has already conducted aerial magnetometer and gravimeter surveys and is proceeding with detailed seismic work. A location will be selected and drilling started this Spring, very likely on the structure of Sainte Juliette 15 miles north of Sfax on the road to Sousse.

Shell is also proceeding with detailed seismic work and the first well started drilling in September on the Zeramedine structure 18 miles southeast of Sousse.

The sedimentary basin appears to be very thick in Tunisia and the chances of finding oil are quite good.

Algeria, with about 720,000 square miles of sedimentary formations, numerous seepages, oil shows in drilled wells, and several small fields, is also undoubtedly a good oil prospect. (See Figure 2.)

In 1946, a French company, S.N. REPAL, was organized with a majority of stock belonging to the French government, and a systematic oil search was started. For lack of good equipment, it began at a low speed, but is now going much faster. A total of around $10 million has been spent already in the exploration of the following areas: a) Chelif-Mitidja Basin (North West); b) Hodna Basin (Central East); c) East of Constantine; and d) Southern Algeria (Saharian Atlas and Sahara proper).

Intensive geological work has been carried out in the first three regions and is still going ahead in the fourth. In the Chelif Basin extensive geophysical work (magnetometric, gravimetric, seismic) was carried out and outlined a large number of structures, the main ones being Djira, Bou Ziri, in the south El Bordj, Bouguirat, Akboube, Ain Zeft, Rockba, El Biod (also called Rabelais), Es Sedra, Warnier, etc.

Some 40 wells have been drilled on the above mentioned and other structures. The goal is to reach the base of the upper Miocene in order to find the sandstone which is productive in the small field of Tliouanet. A good number of the wells drilled had interesting shows of oil, but no commercial production as yet. The best indications were found in Akboube No. 1 and El Biod 1 and 2. Most of the structures however, except Akboube and El Biod, have been tested so far with only one or two wells, which is certainly insufficient to condemn a structure. Nevertheless, the Miocene does not appear to be a very good prospect. Exploration of the deeper formations (between 10,000 and 15,000 feet) required more powerful rigs: two 15,000-foot Emsco jacknife rigs are now on the spot and one is drilling already on the El Biod structure.

In the Hodna basin for many years seepages were known on the banks of Oued Gueterini, 80 miles southeast of Algiers, and shallow pits were dug through the saturated sands to produce a small amount of oil.

The concession belonged to a French company, the Societe Nationale des Petroles d'Aumale. The S.N. REPAL took a 50 percent interest in it and started drilling deeper wells away from the Oued. It found oil in all the wells; 35 shallow wells have been drilled down to depths ranging from 700 feet to 1,500 feet. In addition well OG.20 has been drilled to 6,300 feet.

The structure is a very complicated folding and faulting in which the Miocene, Eocene, and Cretaceous are encountered several times and sometimes in reversed sequence. The producing sands are fairly thin and the same one may be encountered twice in the same well. They are small producers (flowing) but the oil is of good quality. Total potential is unknown since there are no storage facilities and transportation has to be done by trucks. Limits are not completely defined yet, but are roughly 1.5 miles long by $\frac{3}{4}$ to a mile wide. However, the one deep well drilled to a depth of 6,300 feet went into the lower Cretaceous limestone and gave a very good show of gas. A deeper production may exist and will be explored. Farther east, exploration started in October south of Setif where the basin becomes larger.

The East Constantinois (Territory C) region, near the Tunisian border, has a good number of seepages. Drilling will be started there in the near future.

Finally, the very extensive region of northern Sahara (south of the Atlas) is under geological and geophysical study, particularly between Colomb Bechar and Tindouf. Some drilling will take place there in 1952.

Past activity expressed in footage drilled is as follows:

One of the shallow wells being drilled on the banks of Oued Gueterini, 80 miles southeast of Algiers, where saturated sands formerly yielded some production from pits.

Drilling Activity

Year	Feet
1947	18,000
1948	38,000
1949	48,000
1950	89,000

The 1951-1955 program provides for an increase in drilling equipment as follows:

	1951	1952	1953-55
Heavy Rigs	2	3	3
Medium Rigs	2	2	2
Light Rigs	1	1	2
Geological	1	1	1
	6	7	8

The total expenditure provided for the five years is in the neighborhood of $20 million.

Morocco covers a total of around 200,000 square miles, an area slightly smaller than France. A large number of seepages were known as far back as 1900 and a number of shallow wells were drilled with some success. (See Figure 3.) In 1919, one well drilled near Djebel Tselfat gave a small production from the secondary formation. In 1923 this was repeated near Souk el Arba from Miocene sands.

In 1928, the B.R.P.M. was organized and gave birth in 1929 to the S.C.P. (Societe Cherifienne des Petroles). Its working capital is now $13 million and its concessions cover around 6,000 square miles.

Prospective zones are in the triangle Souk el Arba to the north, Fez to the east, and Rabat to the southwest which consists of a deep sedimentary basin made up of three parts: a) a secondary basin to the south on the rim of the Middle Atlas mountains, b) a Cretaceous basin to the northeast, and c) a Neogene basin (Miocene) to the west represented mostly by the Rharb hills and plain.

The small discoveries of Tselfat (1) and Bou Draa (2) in the first region attracted attention to the possibilities of Morocco.

Oil or gas have now been found in the second and third region, respectively at Ain Hamra (3) and more recently at Oued Beth (4) which produces from the basement rock. A generalized section is given in Figure 4. It indicates the various producing zones. During 1950, S.C.P. explored systematically the three prospective regions.

In the secondary basin a deep well around 10,000 feet was drilled on the Outita structure (5). It revealed a very complex situation, broken and dislocated, indicating an overthrust in the general direction of the plain.

A geological hole campaign (6 holes down to 4,200 feet) in the region of Bou Draa (2) indicated the possibility of Jurassic structures below the Prerifaine overlap.

In order to locate the limits of the secondary basin, two wells were drilled and a third one started in 1950 in the neighborhood of Petitjean (7).

The outstanding discovery of 1950 is the field of Sidi Filli, which is a prolongation of Oued Beth (4) and of the same type.

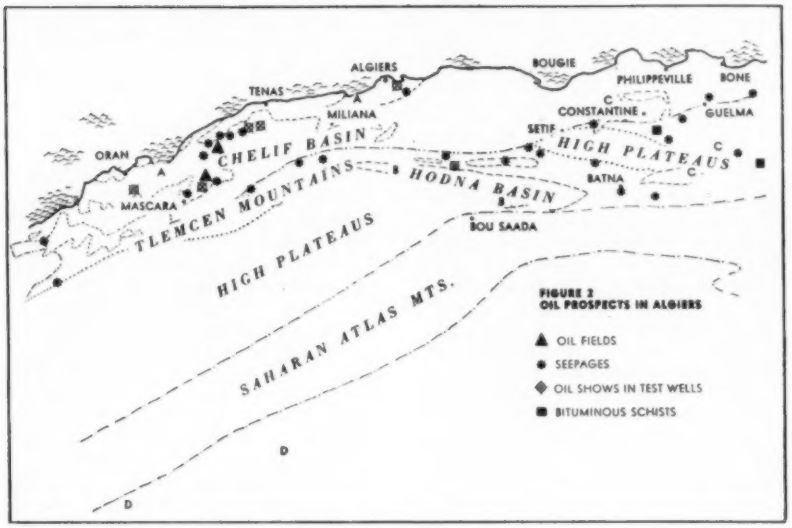


FIGURE 2
OIL PROSPECTS IN ALGIERS

In the Cretaceous basin two wells were drilled at Lalla Zarah (8), but did not find any permeable zone. Two more drilled near Bou Mais (9) indicated the presence of sand layers filled with gas.

In the Miocene basin six holes drilled near the old field of Ain Hamra (3) confirmed what was known of this field: small production from thin shaley sands of low permeability. AH.125 flowed originally 12 barrels per day and dropped rapidly to three barrels. AH.126 dropped from 30 barrels flowing to 12 barrels pumping. The production of Morocco is increasing rapidly as follows:

Year	Barrels
1947	18,000
1948	80,000
1949	105,000
1950	240,000

This production comes mostly from a group of small fields situated across the river Oued Beth. It comprises in the south, the Oued Mellah field, in the center, Tisserand and Baton fields, and in the north, the newly discovered Sidi Filli field. Depths range from 1,200 feet to 5,000 feet.

Production comes from the Paleozoic, which consists of sandstones and hard shales with steep dip (sometimes vertical). They constitute a reservoir through caverns and fractures of very irregular distribution, but salt water or oil is present in a wide territory over 30 miles already known. The whole region is badly cut up by numerous faults which probably control the productive zones. The mechanism of accumulation is not simple.

In 1947, the first well drilled, OB.1, indicated strong shows of oil in the basement complex at a depth of 3,200 feet. It was followed by an active drilling campaign and the fourth hole drilled, OB.7, reached 3,300 feet and flowed 1,800 barrels per day on a two-inch choke. Since then, 126 wells have been drilled to the end of 1950 over a territory extending a length of 12 miles and a width of from three to six miles.

Four fields have been discovered and three are completely drilled:

1—Oued Mellah field. The productive area is 250 acres and the productive section 30 feet. It produces from 14 wells, of around 2,000 feet, about 220 barrels per day, static pressure 59.1 kg/cm.2, spacing 660 feet. Average production of a well on a 1/6 inch choke: 20 barrels per day.

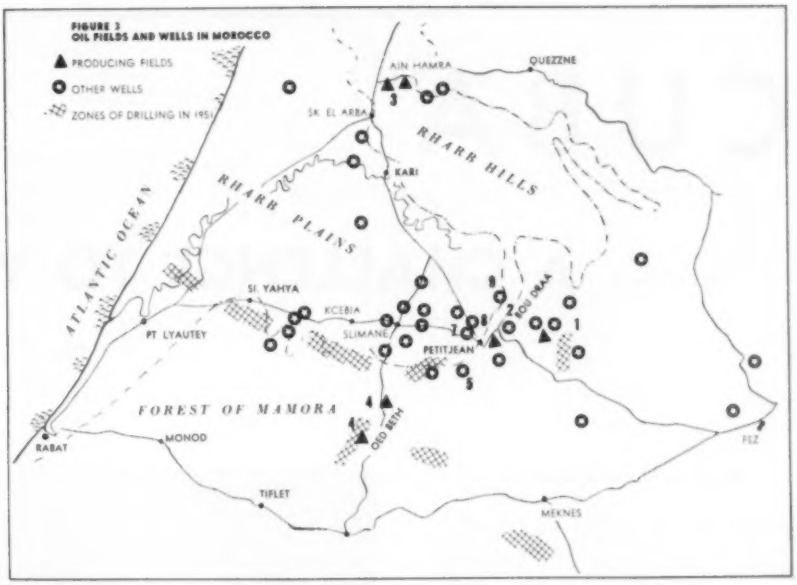
2—Tisserand field is much smaller, only a few acres, with only four wells producing a small amount.

3—Baton field. The productive area is 151 acres and the productive section 165 feet. It produces from nine wells at 3,000 feet around 600 barrels per day of gas-free oil of 0.857 specific gravity, static pressure 114.5 kg/cm.2, unchanged in the last three years. On a two inch tubing, the potential of each well is on the average 600 barrels per day. They are choked down to between 1/32 and 1/6 inch and then produce between 30 and 210 barrels per day. Total drilling and completion time was around 20 days. Spacing used is 1,000 feet.

4—Sidi Filli field was discovered at the end of 1950 and seems to be very promising. The present total production (end of 1951) is 1,500 barrels per day, and is entirely refined on the spot.

The crude gives 7 percent gasoline of low octaine, 9 percent kerosine, 42 per-

Test well CB.4 being drilled by SEREPT in the Cap Bon structure following encouraging results from the lower Cretaceous.



cent good quality gas oil, and 42 percent heavy and fuel oil.

In 1950, 86 holes were drilled, 21 being producers. Total footage is 255,000 feet.

The 1951 program was as follows:

Secondary Basin. Exploration of that basin continued both lengthwise and across the basin.

Miocene Basin. A number of shallow holes were drilled in the coastal plain extending from the ocean to some 20 miles inland to study the sandy zones.

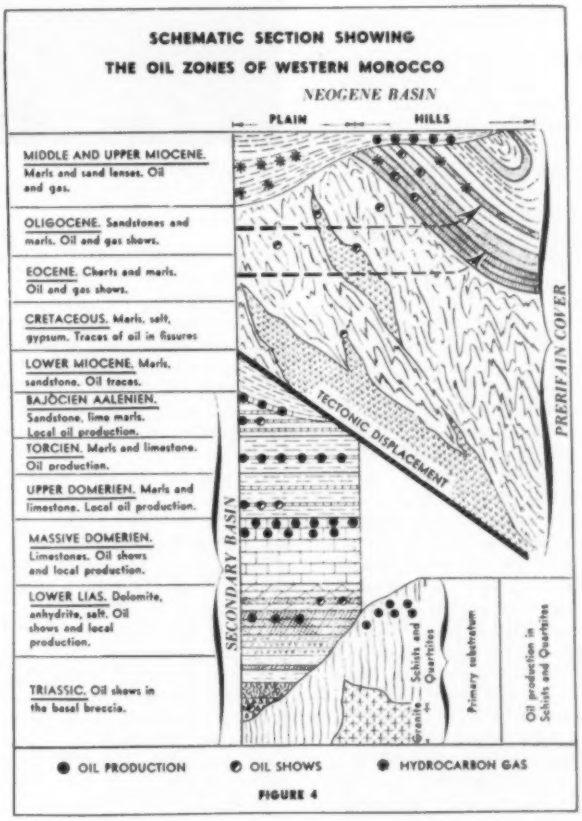
New Territory. Geological studies indicated the presence of a sedimentary basin in the region of Guercif which is a prolongation of the Rharb plain to the northeast. Drilling will be carried on in that region.

In 1952 it is planned to drill 50 to 60 holes of 3,000 feet or less, 25 to 30 holes of 3,000 to 8,000 feet, and four or five holes of 8,000 to 13,000 feet for a total of around 350,000 feet.

Geophysical activity will include the operation of two seismic parties, one gravity party, and one magnetometer party.

As can be seen, exploration for oil in North Africa is progressing rapidly and the results obtained in the last few years are encouraging. It is true that no outstanding discovery has been made (total production for the three territories being around 1,500 barrels per day only), but the sedimentary basins are large (particularly in southern Algeria) and the potentialities deserve the effort.

In the last four years, the oil production of France and the French Union has risen from 800 barrels per day to nearly 10,000 barrels, and there is little doubt that with the exploration program being carried out, it will continue to grow at an increasing speed.


SCHEMATIC SECTION SHOWING
THE OIL ZONES OF WESTERN MOROCCO
NEOGENE BASIN
PLAIN
HILLS
MIDDLE AND UPPER MIOCENE. Marls and sand lenses. Oil and gas.
OLIGOCENE. Sandstones and marls. Oil and gas shows.
EOCENE. Cherts and marls. Oil and gas shows.
CRETACEOUS. Marls, salt, gypsum. Traces of oil in fissures
LOWER MIOCENE. Marls, sandstone. Oil traces.
BAJOCIEN AALENIEN. Sandstone, lime marls. Local oil production.
TORCIEN. Marls and limestone. Oil production.
UPPER DOMERIEN. Marls and limestone. Local oil production.
MASSIVE DOMERIEN. Limestones. Oil shows and local production.
LOWER LIAS. Dolomite, anhydrite, salt. Oil shows and local production.
TRIASSIC. Oil shows in the basal breccia.
SECONDARY BASIN
TECTONIC DISPLACEMENT
PRERIFAIN COVER
Schists and Quartzites
Granite
Primary tabletum
Oil production in Schists and Quartzites
OIL PRODUCTION
OIL SHOWS
HYDROCARBON GAS
FIGURE 4

CUBA

A CHALLENGE TO WILDCATTERS

By Ruth Sheldon Knowles

CUBA is today's wildcatting challenge to the oil industry. The urgent necessity of increasing Western Hemisphere reserves promises at last to bring an answer to the baffling question of whether this island, which has more physical evidences of oil than any other country in the world, actually contains important oil fields.

A new wave of oil interest is surging over the island, and due to remarkably favorable conditions for exploration, it may well be another Canada in the making.

Active geophysical exploration is being carried out in the southern part of the island and plans for exploratory drilling are being made by two independent groups. In the business circles of Havana, oil and oil concessions are almost as much a topic of conversation as Midland or Tulsa, for Cuba, unlike other foreign countries, is one place where the chips are not too blue for the independent operator and where operating conditions compare favorably to those in the United States.

There is only one answer to the Cuban oil enigma of why there have yet been no major discoveries in a country where Columbus wrote the first oil report, describing seeps he found. That answer is drilling enough wells to localize the oil that the consensus of geological opinion believes is there. Cuba is a geological challenge that has been argued over more than it has been drilled in. Excepting wells in Cuba's three small producing fields, only 27 major exploratory wells have been put down in Cuba to date. Although practically all of them had indications of oil, none was commercially productive. Twenty-seven dry holes in a pretroliferous island extending over 28 million acres, plus great submerged

Pinar overthrust sheet and residual mogotes, Sierra de los Organos, Pinar del Rio province.

shelves, is a mere beginning, as the exploration history of every oil area in the world confirms.

That Cuba is real oil country is the opinion of two of the world's most eminent geologists, Dr. E. DeGolyer and Wallace Pratt. Dr. DeGolyer did some of his first geological work in Cuba, traveling the island on muleback for three months in 1916, and his report is still a classic concerning the northern areas he covered. Dr. DeGolyer today states that the problem in Cuba is not whether there is oil, but how to localize where it may be.

Mr. Pratt, writing in the recently published "World Geography of Petroleum," comments on the impressive surface evidences of the occurrence of petroleum in Cuba and states that "while several deep wells have been drilled, exploration to date has been far from definitive." He feels that the development of petroleum resources in the Caribbean area is "far from complete; in many promising localities it has hardly been initiated."

In the Gulf-Caribbean area, which next to the Middle East is the greatest oil producing center of the world, the West Indian islands and the Central American republics, excepting Mexico, have never been systematically explored, as Mr. Pratt points out, in spite of their favorable evidences of petroleum. After the development of the big fields of Mexico, Venezuela, Colombia and Trinidad, major oil company interest shifted to the spectacular Middle East. Oil exploration is never systematic. It is more like a game of global hop-scotch with oil explorers shuttling back and forth across the world.

A controlling factor in the hop-scotch game today is the realization that oil is a political as well as a chemical substance. Nationalization of oil resources and restrictive laws due to growing nationalistic concepts have been the greatest obstacle to the development of Latin American oil potentialities since the 1938 Mexican expropriation. Iran's nationalization move now shrouds the Middle East picture in an ominous fog.

Under these circumstances, Canadian

LOCATION AND DEPTH OF WELLS DRILLED IN CUBA:

MAP REF. NO.	COMPANY	WELL NAME & NO.	TOTAL DEPTH (Feet)
1	Esso Cuba	Guanal 1	3,212
1	Esso Cuba	Guanal 2	2,147
1	Esso Cuba	Rojas 1	3,449
2	Esso Cuba	Banos 1	8,605
2	Esso Cuba	Banos 2	3,012
3	Atlantic	Prosperidad	2,283
4	Atlantic	Maria	3,240
5	Shell	Ariguanabo 1	5,272
5	Shell	Ariguanabo 2	10,035
6	Shell	Quirade Melena 1	3,646
6	Shell	Quirade Melena 2	4,000
7	Shell	Bacuranao	
8	Atlantic	"Sigoney"	5,200*
9	Atlantic	Criollo 1	6,020
9	Atlantic	Criollo 2	6,000
10	Atlantic	Grace C 1	4,104
10	Atlantic	Grace C 2	4,108
11	Esso Cuba	Lee 1	1,663
11	Esso Cuba	"T" 1	1,389
12	Shell	"Mercedes"	4,013*
13	Motembo Field		
14	Gulf Oil	Gulf 1	5,100*
15	Gulf Oil	Blanquizal III	11,218
16	Atlantic	Carco 1	10,000*
17	Tarahueca Field		
18	Atlantic	Cunagui 1	4,000*
18	Atlantic	Cunagui 2	4,000*
19	Shell		9,000
20	Gulf	Now preparing for 3rd well.	
21	Alberto Quadreny	a) Quadreny 1	1,625
		b) Quadreny 2	997

* Approximate

oil development has been a bright star. For the same reason Cuba is more attractive than ever before. Not only is it potential unexplored oil country, but its petroleum laws are encouragingly favorable to the oil explorer. Furthermore, Cubans are as firmly opposed to nationalistic policies as are North Americans. The psychology of the two groups is closely allied. This is a natural result of the close interchange, both in commerce and travel, between the two countries and the fact that the Cuban concept of democracy and the freedom of the individual is like that of the United States. Cuba is a prosperous nation with a standard of living higher than that of any other Latin American country. Cubans are hard workers as is testified to by the fact that this one small island with 5,500,000 population produces nearly half the world's sugar.

The Cuban peso and the American dollar are interchangeable and both are legal tender in Cuba. Legal documents in Cuba written in Spanish and English may even include the provision that in case of controversy over interpretation, the English text will prevail. Accommodations and facilities are so Americanized in Cuba that the American traveler feels at home any place in the island, except that home was never so beautiful or quite so delightful. Cuban friendship for Americans is a tangible thing.

All these factors add up to a highly favorable political, economic and social climate for the investment of American capital. Geographically, conditions are ideal for the development of an oil industry. Exploration in South America has always been difficult, hazardous and costly due to jungles, mountain chains, lack of roads, supply problems, malaria, great distances and in some areas even hostile Indians. However, Cuba, averaging fifty miles in width, and with a central highway running its 785 mile length, offers none of these problems. With its year round mild tropical climate, no malaria, no poisonous snakes or predatory animals, it is correctly called the "pearl of the Antilles." Its very location at the center of the Western Hemisphere, dominating the four entrances of the "American Mediterranean" would give Cuban crude oil a competitive advantage over other areas in supplying the Atlantic seaboard and Western Europe.

All these favorable conditions make it possible for the independent operator to compete in the search for oil, which in many places is almost an impossibility.

The present exploration spotlight is focused on Gulf Oil Corporation's activities off the island's north shore and the exploration program in the southern part of an independent group, the Cuban Venezuelan Oil Voting Trust.

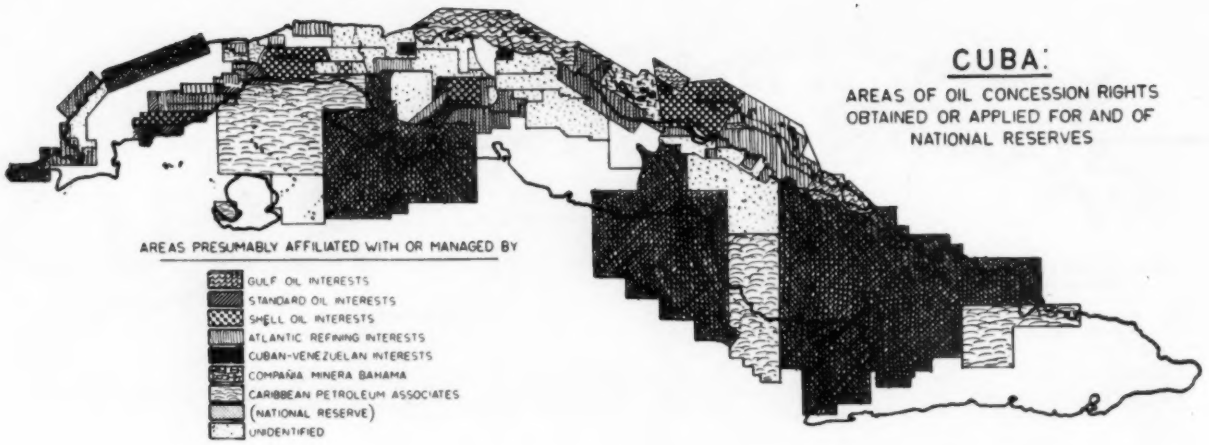
The search for oil is always exciting and there is drama even in the drilling of a shallow cable tool test beside an Oklahoma highway. But the emotional factors involved in oil finding are intensified to the highest degree for anyone who visited Gulf's wildcat in the shallow waters eleven miles off the north coast in the Key of Blanquizal.

The tiny mechanical island in the Caribbean, inhabited by Texas and Oklahoma drillers, Cuban crews, Swedish and Finnish marine engineers, was Gulf's second Cuban wildcat, which suspended drilling in February at 11,218 feet. Gulf has concentrated its very active exploration program on Cuba's north coast as part of a wider regional exploration picture. Gulf holds concessions in the Bahamas and British Honduras, and Gulf's geologists believe that these areas, together with the Cuban north coast, all tie into the same geological picture, flanking a large sedimentary basin. Gulf's deep dry wildcat in the Florida Keys, Superior's deep dry wildcat in the Bahamas, Shell's deep test in the Cuban Coco Key, and Gulf's first Cuban offshore wildcat 60 miles west of its second, are the beginnings of an effort to think in such large regional terms.

Gulf is already core drilling to make a location for its third Cuban offshore wildcat, some 200 miles east of the present one, between the Keys of Guajaba and Sabinal. Cuban excitement ran high when gas was reported to have been discovered by one of the core holes. Gulf's famed airborne magnetometer has been used in its Cuban exploratory work, but the gravity meter has proved to be of more specific help.

The Blanquizal test was spudded in April 24, 1951. Offshore drilling anywhere has its own peculiar problems and those problems are multiplied in a foreign venture where it is the only such well being drilled. However, due to the ingenuity of Cuban Gulf manager R. J. Macaulay, difficulties have been minimized. Under the circumstances, this test set a record, averaging 50 feet of hole a day, including the trips, and averaging 150 feet per bit in drilling which is comparable to West Texas Permian. In 9,200 feet of drilling there were only 12 fishing jobs, of which all but one took only one trip to solve. The crew drilled with salt water and a mixture of sawdust and native clay. Losing circulation never perturbed Gulf's veteran tool pusher, Bob Tickle, who drilled 8,000 feet in Gulf's Florida well with no circulation. When circulation was lost it was full steam ahead, except for stops to core. And it was *literally* full steam ahead, for despite a fresh water problem, Gulf used a steam rig on this test, as it was available from its Venezuela operations.

A veteran tanker barge, the Juniata of Philadelphia, vintage 1906, did double duty as a house-boat for the crews and storage capacity for fuel oil. The 225 barrels of fuel oil needed daily in this search



was almost as much as the island produces.

Gulf's limestone expert, Dr. Max Littlefield, who was the geologist on the well, is optimistic about the possibilities of finding oil in spite of the failure of the first two wildcats to find it. At present, the company is reviewing all the information it has assembled on Cuba in the light of the results from the Blanquizal well before scheduling the drilling of the third test.

Gulf's first wildcat, completed in December, 1949, was as baffling and tantalizing as any test could be. It was drilled to 5,045 feet and had 2,500 feet of oil impregnated formation. The oil tested five gravity and the Pittsburg laboratory technicians suggested that "this is not oil; it's a form of energy we have not learned how to use yet." There was considerable gas at several points and it is still an open question, with arguments on both sides, as to what might have been found if the test had been carried deeper, for they were still in the oil impregnated formation when the well was abandoned. This was the Aptychus formation which is believed by most geologists to be the most important source rock for oil in Cuba.

Just as Gulf has its regional reasons for concentrating on north coast offshore drilling, the independent group, the Cuban Venezuelan Oil Voting Trust, has a new approach to the geology of Cuba in concentrating its exploration activities in the southern part of the island. The CVOVT, a group of independent Cuban, Venezuelan and American oil and business men headed by Warren W. Smith, former president of Pantepec Oil Company of Venezuela, manages 24 corporations which hold some 17 million acres of exploration concessions, lying principally in the southern part of the island and its insular shelf.

Cuba's outstanding geologic feature is a broad central anticlinal arc, convex northward, from the island's western tip to the Cauto River valley. This divides the western and central part of the island into two groups of separate basins favorable to oil accumulation, north and south of the uplift. The majority of the principal wildcats drilled to date have been located on the north coastal and central uplifted regions, undoubtedly because surface manifestations of petroleum are more abundant in the central and northern regions. The tests have proved that this area is extensively disturbed by sharp folding, overthrusting, faulting and igneous intrusions. The belt of oil seeps and asphalt deposits along the north coast indicates that millions of barrels of oil once accumulated in this northern basin escaped during periods of movement and fracture, leaving the residual asphaltic hydrocarbons. Although the tests to date in this area have failed to discover any major accumulation of oil, the existence of small fields in the complex geological picture is proved by Cuba's three producing fields, Bacuranao, Motembo and Jarahueca.

Recent extensive geological and geophysical studies carried out by CVOVT, made by Oil Properties Consultants, Inc., of Pasadena, under the direction of Dr. Rene Engel, and by Cecil Hagan, of Houston, and Basil Zavoico, of New York, indicate that the best prospective areas of Cuba are in the southern portion of the island as the southern basin areas are comparatively unaltered and show a minimum disturbance. The geologists state that they consider the chances for discovering commercial quantities of oil in Cuba excellent and that the oil possibilities in Cuba are equal to or better than those in any other wildcat country.

CVOVT currently has two gravity meter and two magnetometer crews in the field. This work is being carried out by Exploration Surveys, Inc. of Dallas.

There are other new independent ventures starting on a smaller scale. Caribbean Associates, with concessions in the south, is understood to be planning several wildcats in association with Texas capital. A new independent company has been organized by Clarence Moore, an attorney formerly with the American Embassy staff in Havana. He plans to drill near oil seeps in the Santa Clara central region.

There continues to be active drilling interest by Cuban and American small independent operators in and around Cuba's three oil fields. This is being stimulated by the government Comision de Fomento's recent purchase of a $500,000 rotary drilling rig complete with casing which is to be made available on a lease basis to independent operators to enable them to plan deeper drilling than their own cable tools have permitted to date.

"The reason independent operators here have not achieved any more development than they have is because we are using about the same methods Col. Drake did," is the wry comment of one independent American oil operator who has been active in the development of Cuba's principal oil fields.

These three fields, Motembo, Bacuranao, and Juarahueca, which have produced only a total of some 3,000,000 barrels of oil since their respective discoveries in 1881, 1914 and 1943, have received little attention in discussions of world oil possibilities because of their insignificant production. However, they are interesting fields due to their peculiarities.

The Motembo field, discovered near gas seeps, is nearing depletion. It produces pure naphtha ranging from 54 to 62.7° API, which can be used direct from the well as automotive fuel and as superior cleaning fluid. The 1,500 wells range from 350 to 3,400 feet. Some of them had an initial production of 775 barrels a day, but are now bailed at an average production rate of a tenth of a barrel a day. The naphtha occurs in pockets in siliceous zones of the serpentine where it comes in contact with the Aptychus (Lower Cretaceous) limestone. The field offers possibilities of extension and Dr. Jorge Brodermann, director of the Cuban Geological Survey, estimates that if deeper drilling of from 6,000 to 8,000 feet is carried out in this area, oil may be found.

Bacuranao oil field, in which operations have practically ceased as it cannot now produce more than a barrel a day, has produced an estimated total of 160,000 barrels of oil from 60 wells ranging from 200 feet to 2,070 feet. Drilled near asphalt seeps in 1914, the significance of this field is proof of the existence of oil in Cuba's Mesozoic rocks. A mile north of the field is a very odd recent wildcat. Drilled to 3,000 feet, the well flows heavy black oil for about three days, then the flow stops for about ten days and then the cycle repeats itself.

Jarahueca, Cuba's most recent field, was brought in in 1943 near gas and oil seeps by a 356-foot discovery well and produces where the serpentine contacts the Aptychus. Some 200 wells drilled on 250 acres have produced about a million barrels of oil. The wells average 1,270 feet. This field has shown unusual behavior. Many of the wells have been deepened as many as five times, as a producing horizon dropped beneath a profitable level. Each new producing horizon produced a different grade of crude. As closely as the wells are drilled, they do not produce the same crude from similar depths and there also may be a different number of producing zones in nearby wells. Neither are pay zones directly connected, as production from a well is not affected by nearby production.

On a smaller scale, but just as in Oklahoma and Kansas, there are many small concessions owned by individuals and deals are constantly being promoted for new shallow tests near oil or gas seeps. Recently two American geologists drilled a total of 7,000 feet of hole, all dry wells, with a cable tool rig at a cost of $20,000. A meat packing plant near Havana in search of water drilled into oil at a few hundred feet, starting a flurry of interest. Cuban independent operators drill on doodlebugs, too. A shallow well is being drilled a hundred yards off the main highway between Havana and Matanzas on the strength of a wiggle stick.

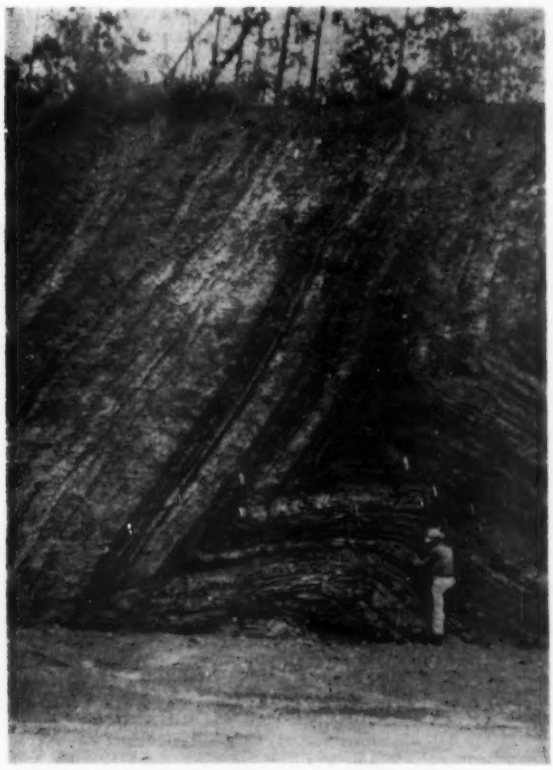
Despite the handicap of being understaffed, the Cuban Geological Survey, under Dr. Brodermann's direction, and the Department of Mines, directed by Ing. Antonio Calvache, are unremitting in their efforts to increase the geological information of Cuba and to stimulate both Cuban and foreign interest in Cuba's development. These departments have produced some fine maps and reports. The current major project is aerial mapping in collaboration with the U.S. Geodetic Survey.

Aside from Cuba's importance as a potential new oil reserve of major importance, it would be of great economic value to Cuba to be able to supply its own oil needs. With a production of from 200 to 300 barrels daily, Cuba imports 41,000 barrels of oil and products, for it has no domestic fuel supply except charcoal and cordwood.

Standard Oil of Cuba has a 4,200 barrel refinery which handles practically all refining done in Cuba; however, the company plans to invest $17,000,000 in expanding this refinery. Standard of New Jersey has also recently concentrated all its Caribbean area marketing companies in Cuba. At present, Standard of Cuba is not active in exploration although it still retains concessions. Shell and Atlantic stopped active exploration during the last few years, but also retain concessions. These three companies drilled the principal unsuccessful wildcats in the north coastal and central uplifted regions.

The fact that these companies are inactive at present is of little significance in evaluating Cuba's potentialities, as they have major commitments in other proven areas.

Cuba remains wildcatter's territory and an inviting field for independent operators who in the United States have been responsible for a majority of the discoveries.

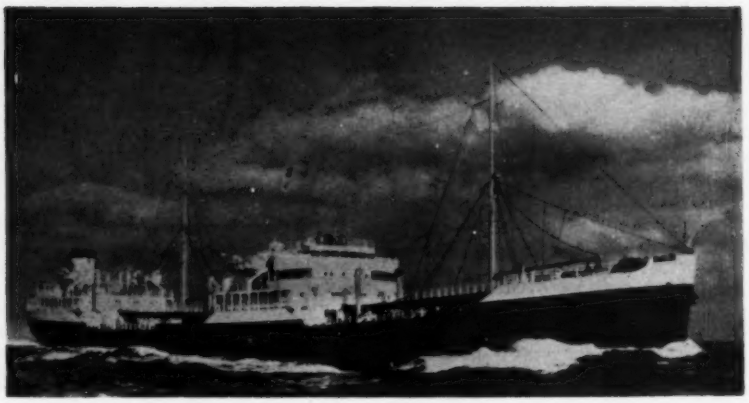


Overturned fold in upper Cretaceous Cayetano formation shows compression from left. View near Consolacion del Norte, Pinar del Rio province.

Comparison of Concession Terms and Operating Conditions in Western Canada and Cuba

Points under Comparison	Province of Alberta	Province of Saskatchewan	Republic of Cuba
Max. exploration acreage allowed to one entity	200,000 acres	250,000 acres	750,000 acres
Max. exploration period	3 years	2 years	3 years
Guarantee deposit on max. acreage	$25,000	$1,000	none
Max. exploitation acreage allowed to one entity	100,000 acres	250,000 acres	750,000 acres
Annual tax per acre	$1.00	First year: $0.50 thereafter: $1.00	First ten years: $0.04 Second ten years: $0.08 Third ten years: $0.16
Exploitation period	21 years	21 years	30 years
Permissible extensions of exploitation period	21 years	21 years	60-day option to accept best third-party terms
Drilling Obligations			
Start of first well within	1 year	15 months	5 years
Start of further wells	90 days after discovery well. Gov't. may demand more rapid drilling	Min. yearly drilling expense of $2,000 for every 1920 acres	Every 5 years thereafter one well to 4000′ for every 60,000 acres
Royalties	12%	15% if production exceeds 200 b/d	11%
Foreign exchange control	very strict	very strict	none, except 2% currency export tax

John Lamb, head of Shell's marine research and development department.



Starboard view of the Anglo-Saxon Petroleum Co. 12,250 dwt experimental tanker "Auris." All photographs with this article courtesy Shell Photographic Unit, London.

Gas Turbine Powered Tanker Completes First Voyage

By E. Lawson Lomax

ON JANUARY 22, a company of engineers, shipbuilders and technicians were given the opportunity by the Shell Company of inspecting the 12,250 dwt oil tanker *Auris* at Southampton on the completion of her first round deep sea voyage after having one of her four Sulzer diesel engine sets replaced by a gas turbine, this being the first merchant ship to utilize such means of propulsion.

The *Auris* was built four years ago for Shell by R. & W. Hawthorn Leslie & Co., Ltd., to the design of John Lamb, as an experimental tanker to be used for experimental work while still acting as a normal working tanker. After the successful work on the *Auricula* for using Bunker C fuel in diesel engines, she has used a similar fuel in her diesels, which is the same type also used in the gas turbine, and has a minimum viscosity of 1500 secs. Redwood No. 1 at 100° F.

The only special precaution taken in preparing this fuel for its present use as against its use for direct steam raising is mechanical purification and filtering. It is well known that many of these residual fuels contain impurities in the form of alkali metal salts, as well as oxides of various metals such as iron and vanadium, and the fear has been expressed in many quarters that the presence of these adventitious bodies will be detrimental to the turbine blades on continued running. It is still early in the history of the gas turbine to say whether such fears will be justified, but it is safe to say that the metallurgy of the materials available for the manufacture of turbine blades is now so advanced that alloys will be produced which are not unduly degraded from this cause.

It would appear that the attack of the problem on this basis has more prospect of success than one based on the chemical elimination of these bodies from the fuel, which in the light of present chemical knowledge of the problem could not be reasonably economical, or by the use of additives in the fuel to prevent fouling of the blades, which also would not be very economical.

The question of the use of gas turbines for marine propulsion is one of great interest, and has occupied the activities of design offices and ship builder's engineers all over the world, but the fitting of a gas turbine unit into the *Auris* marks the maximum progress which has so far been attained in this development, which from the ship's first successful voyage using this form of propulsion is considered an outstanding achievement.

After the bench trials of the gas turbine unit had shown its practical possibilities, one of the Sulzer diesel units was removed from the ship and replaced by the gas turbine unit at the yard of the original builders, after which the vessel underwent sea trials lasting 48 hours, for six hours of which, with a strong wind and a moderate sea, the gas turbine was the sole means of propulsion. An average speed of over seven knots was attained, against a normal speed under full power of 12 knots during this test.

Immediately after the trials the tanker left the Tyne for Port Arthur, Texas, on her first ocean voyage with the new engine. The outward voyage of 4,905 miles was covered at an average speed of 9.21 knots, including six days of continuous heavy weather when the speed of the normally 12-knot ship was on occasions reduced to seven knots.

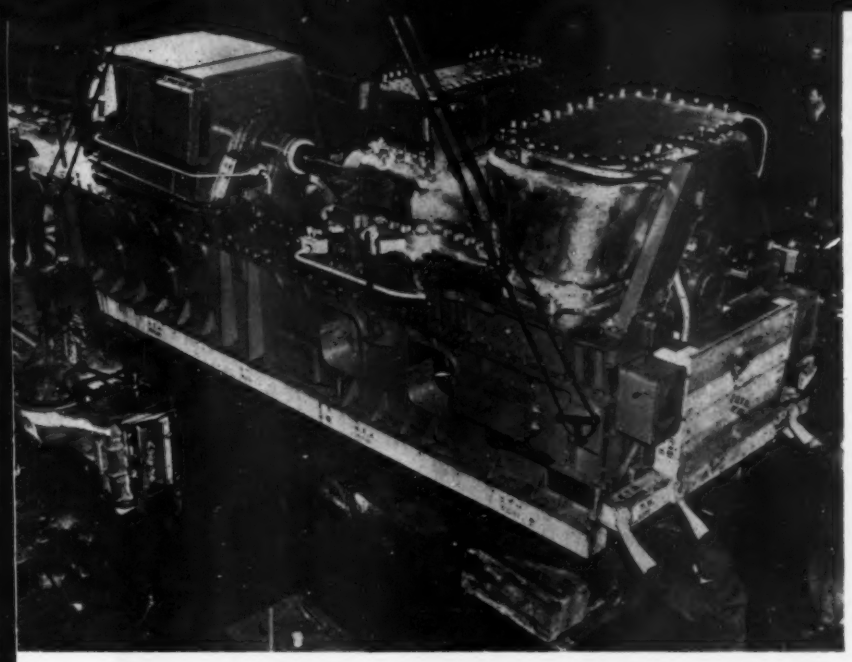
The gas turbine ran continuously in conjunction with the three diesel units throughout the 22-day voyage, without need to stop or to reduce the rotor speed, while operating conditions varied only to the extent expected, when the atmospheric temperature rose from 52°F to 81°F. The *Auris* then loaded a full cargo of casinghead gasoline and proceeded almost immediately to Curacao.

On the return voyage from Curacao, she visited Avonmouth, Swansea, Hull, Rotterdam, Oslo, and Southampton for the purpose of discharging cargo. The distance covered by the round trip was 13,211 nautical miles and the machinery operated for 1,391 hours. During this time, the gas turbine operated without any involuntary stop or mechanical difficulty of any kind, nor were any repairs necessary when in port.

The lubricating oil used represented a consumption of less than ¾ gallon per day, which is considerably less than that consumed by a diesel engine of equivalent power.

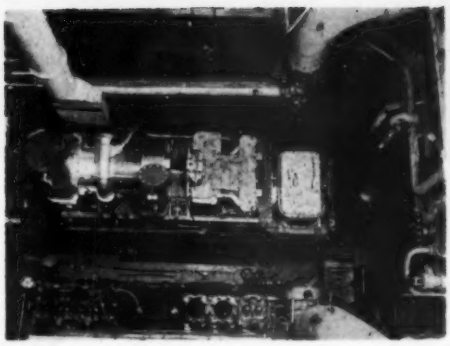
Fuel consumption averaged 0.75 lb. per bhp/hour, which is comparable to that for steam turbine installations of equivalent rating.

On her next crossing of the Atlantic the *Auris* will be propelled solely by the gas turbine burning 1,500-sec. fuel. While the results so far obtained are eminently satisfactory with this new form of propulsion, time is necessary before its full value can be determined. At the same time the sponsors feel justified in considering that complete success is not far away. When the results of extended trials are analyzed, and from these trials any necessary modifications are embodied, the gas turbine may rival turbine and diesel installations in reliability and performance, and possibly surpass both with regard to capital and maintenance costs.



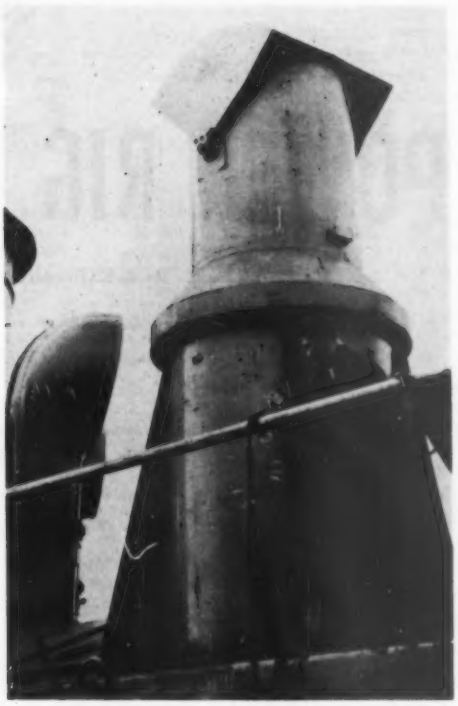
Gas turbine, alternator and bed plate ready for installation.

Installing top half of the casing of the low pressure turbine.

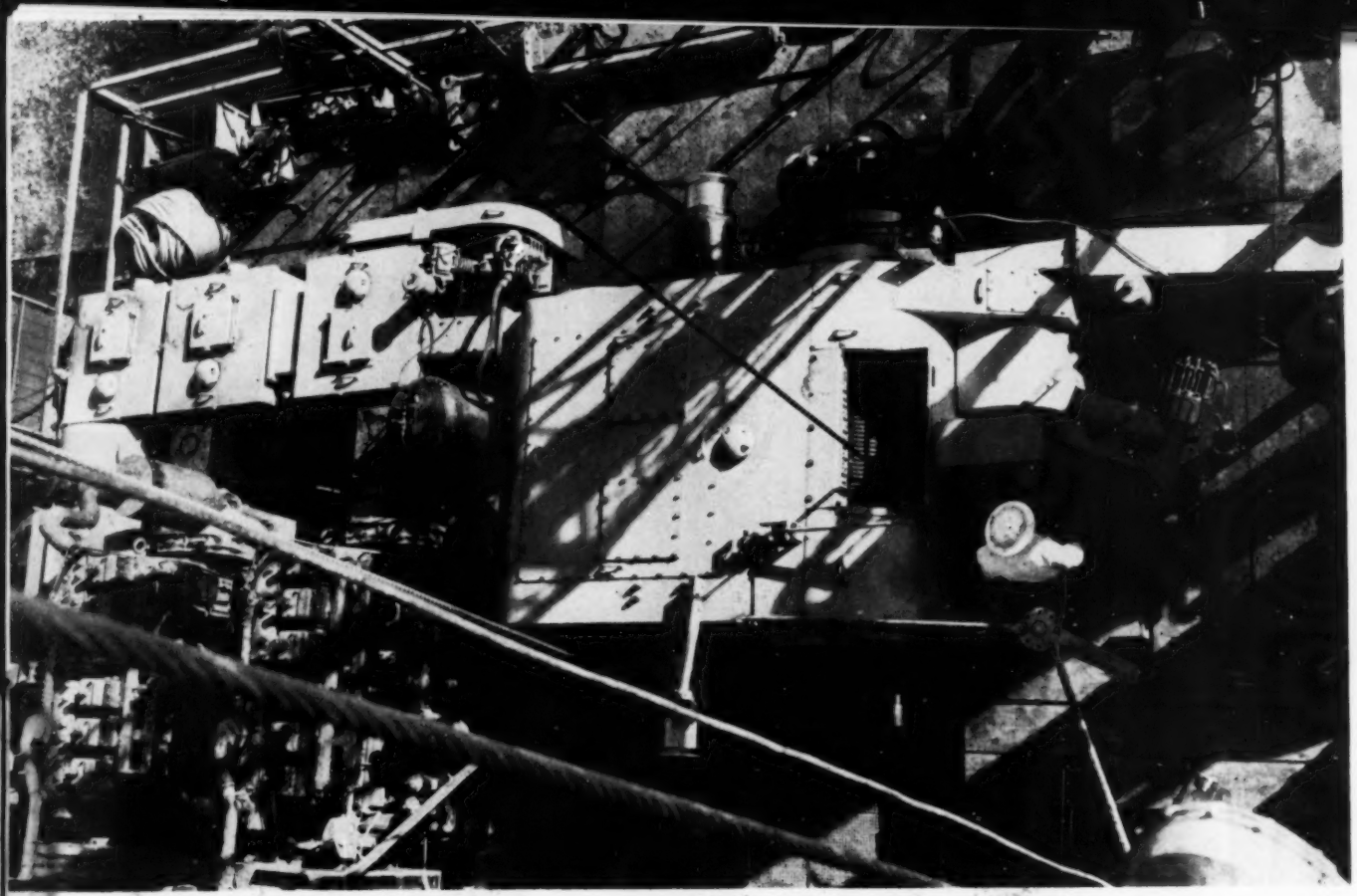


Overhead view showing gas turbine in place between existing diesels in engine room of "Auris."

Instrument panel and controls of the gas turbine of d.e.s. "Auris."



Welding the air intake and exhaust cowl of the turbine. Mounting of these elements is forward of the funnel.



Overhead view of drawworks and compound of medium depth rig which has been designed with a drawworks structure only eight feet wide with easy access to sectional compound cases mounted on engine skids and to drilling controls. Rig is designed for either two or three engines and single or double pump. Mechanical drive may be modified for fluid coupling or torque converter. Photo courtesy Bethlehem Supply Co.

POWER RIG HOISTS

By J. E. Brantly

The following article is an abridgement of a chapter of the new Fifth Edition of Brantly's Rotary Drilling Handbook* which is to be published this month. The Brantly Handbook has been the standard work on the subject of drilling techniques and equipment since the first edition was published.

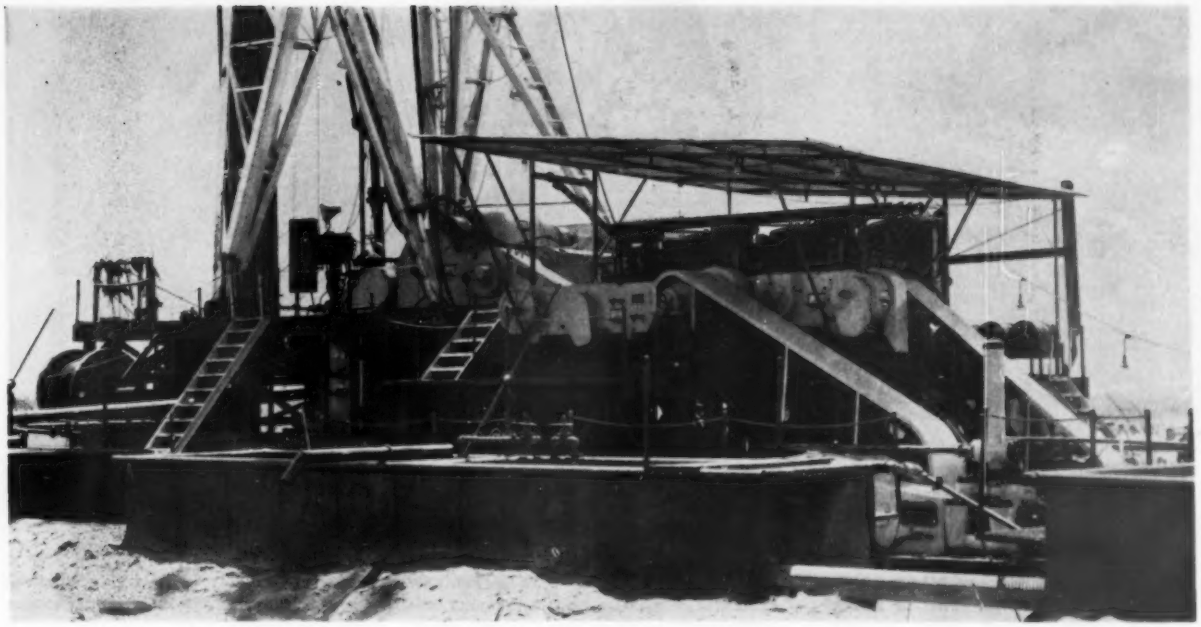
**Rotary Drilling Handbook, 5th Edition, $10.00 postpaid, World Petroleum, 2 West 45th St., New York 36, N. Y.*

WITHIN the past few years, oil fields have been discovered and drilling has been required in areas where the use of steam equipment is prohibitive due either to excessive fuel costs or lack of suitable boiler water or both. The Permian Basin of West Texas is a case in point. This condition has led to the increasing use of power rigs and the increased demand for this type of rig has resulted in several manufacturers of drilling equipment designing and placing on the market hoists particularly adapted to mechanical drive, or briefly, mechanical drilling rigs.

A mechanical drilling rig is, for purposes of this discussion, considered to be a drilling rig driven by gas, gasoline, butane or oil engine prime mover, either single or in multiple, whose power output is transmitted to the hoist by means of V belts, chains, gear boxes, hydraulic couplings, hydraulic torque converters, or any combination of the above.

Drilling rigs designed and built especially for internal combustion prime movers have recently appeared on the market in sizes varying from completely unitized truck or trailer mounted "package" rigs capable of drilling 2500 to 6000 foot holes to semi-unitized rigs capable of drilling holes to a depth of 12,000 feet. In general, these rigs are well engineered and have been designed as a unit from the

Medium-depth rig designed for 1,000 net horsepower input and for drilling from 7,500 to 12,000 feet using 4½ inch drill pipe. Photo courtesy Unit Rig and Equipment Co.



pump or power group transmission through the hoist. Such a rig will consist primarily of a power plant, hoist, pump and rotary table, the remainder of the rig being exactly the same as a conventional steam rig. Hoists have been built for and used on 20,000-foot holes.

These modern hoists especially designed for mechanical rigs vary from small completely unitized machines to large semi-unitized machines, from machines with only one friction master clutch to machines entirely friction clutched.

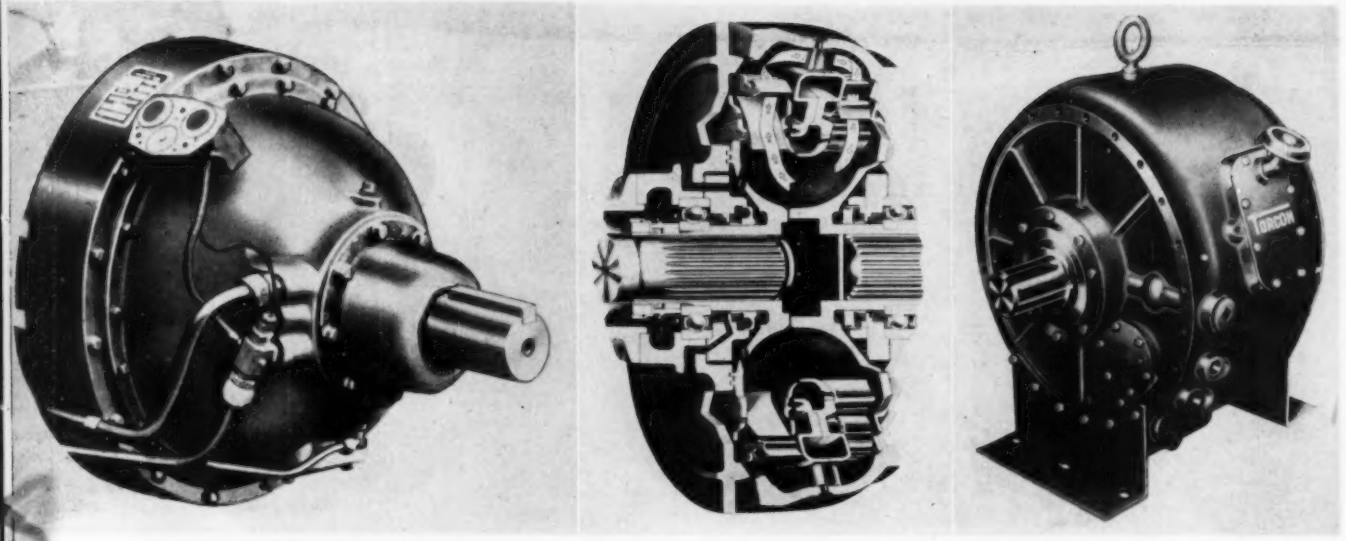
Most modern hoists have from four to eight speeds forward, one or two in reverse and from two to four speeds to the table. These various speeds are obtained through the use of chain transmissions, gear boxes, gear trains or a combination of any of the above. The most recently designed hoists of the transmission type appear to favor an oil bath chain transmission although there can be no substantial objection to a properly designed gear box. The torque characteristics of an internal combustion engine are such that a large number of speed changes are required in order that the engine operate at its best performance point and that the driller be able to obtain the speeds necessary for efficient drilling. Theoretically, a hoist with an infinite number of speed changes between the prime mover and the hoist would be the ideal hoist for mechanical drilling. This ideal condition cannot be obtained practically by the use of chains and sprocket transmissions or gears such as outlined above. Therefore, a compromise is reached and the number of speed changes provided that it is possible and practical to provide in any particular hoist. As is usually the case with compromises, the result is often not completely satisfactory.

In general, it may be said that very little trouble is experienced with any mechanical rig except when going in the hole at depth. Human nature is such that the average driller who, when going in the hole, customarily runs the block up in high gear, will not stop the rig and change to some lower gear that will provide the amount of torque necessary to lift the weight of a long string of drill pipe and release the slips. Unless the principle of hydraulic torque conversion is incorporated in the hoist, then certainly the hoist selected should have provision for easily and rapidly changing from a high to a low speed without having to stop completely all movements. If such a change of speed and torque is not easily and readily available then the common tendency is to slip the master clutch in an effort to raise the drill pipe the short distance necessary without stalling the engines. Quite naturally this results in burnt out clutch facings and short life for any friction clutch. Rather recently an attempt has been made to apply the principle of both hydraulic couplings and hydraulic torque converter to mechanical drilling rigs. Of the two, the torque converter has shown the best results and promises to solve the problem of supplying high torque at slow speeds, which is greatly to be desired in a drilling rig.

Providing drawworks clutches capable of satisfactory operation in modern drilling practice imposes a number of considerations by the manufacturer. Varying heavy loads are hoisted, and for smooth easy pick-ups the hoist should be capable of "feathered" application. Drawworks clutches must assure a quick full engagement under the heaviest loads, and in certain applications be capable of continuous operation in the released position. It is important that in the released position the opposing elements of the clutch must not contact each other.

Under these conditions, it is essential that the clutch generate a minimum of heat and this must be rapidly dissipated without auxiliary cooling equipment.

Within the past very few years some manufacturers have designed and built power rig hoists that have one or more speeds available for hoisting the empty blocks, and without stopping to change speeds in the transmission, a low speed and high torque is provided to the drum



Torque converters used in current rig hoists. Left to right—General Motors, Twin Disc, Torcon. Dresser Equipment Co. photo.

through the low drum clutch to raise the drill pipe off the slips. This is accomplished through a jaw clutch, or more generally through an air-operated friction clutch.

Power rig drawworks, now popular and widely used, are made by a number of oil field machinery makers. In fact these power rig hoists are manufactured by several concerns which have never built steam hoists.

These power rig drawworks for the most part consist of a drum shaft assembly and two rear shafts grouped in a "transmission," also a catshaft and rotary drive countershaft, and usually, six hoisting speeds and a selection of three rotary table speeds. A few models are available with a greater selection of drum and table speeds.

The hoisting drum assemblies on the more modern designs are equipped with two friction type clutches providing convenient high and low drum speeds beyond the selective "transmission." There is some variety in friction clutches including mechanically operated expanding and disc types, the same types actuated by air cylinders and, finally, the direct air actuated models. All are utilized by various manufacturers.

The trend in modern power rig design is to full air control of all friction clutches and engine throttles. The modern power rig is conveniently and easily operated by the driller.

The inclusion of two friction drum clutches tends to this ease and convenience of operation and is a development particularly adaptable to internal combustion prime movers. The modern power rig includes fully lubricated chain drives and also a full complement of roller bearings.

The higher three or four speeds are utilized for making trips employing all engines in the drive group. The lower speed ratios are available for slow movement of the drill pipe or casing and hoistings operations with a single engine.

Table I includes four sizes of rigs made by one manufacturer and is more or less representative of similar equipment available from a number of makers.

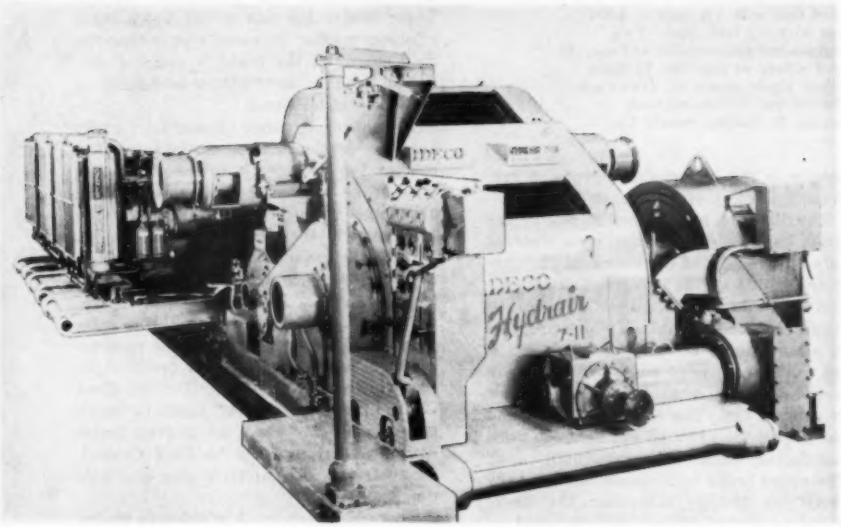
These power rig hoists are powered by drive groups or "compounding units" including two, three, or four internal combustion engines.

Lighter, single engine hoists also come under the heading of power rigs and are available with engines up to 200 hp. Such hoists find wide application for shallow drilling, remedial operations and production service work. These lighter hoists are frequently portably arranged on trucks or trailers together with foldable derrick structures.

The hydraulic coupling as applied to drilling rigs acts primarily as a shock absorber between the drilling mechanism and the internal combustion engine. Although no multiplication of engine torque is obtained through the hydraulic coupling, it will transmit the developed engine torque at the output shaft, regardless of the speed. This piece of equipment permits an internal combustion engine powered rig to perform more like a steam rig in that full engine torque is available to the drawworks at stalled speed. Of course, it is still necessary to use the usual amount of speed changes through the drawworks, for efficient operation. Hydraulic couplings have been used very successfully in foreign oil fields for many years. Perhaps this is explained by the fact that the hydraulic coupling was developed in Europe, and only within recent years has it been manufactured in the United States. There are many rigs operating in the domestic field now equipped with hydraulic couplings and it seems

Typical Range of Rig Sizes

	5000′-	6500′-	8000′-	10,000′-	13,000′-
Drilling Depth Range	7500′	10,000′	12,000′	16,000′	20,000′
H.P. Rating	550	800	800	1300	2000
Drum Diameter	22″	25″	26″	30″	36″
Drum Length	49″	48¾″	46″	56¼″	61¼″
Approx. Drum Shaft Diameter	8″	8¼″	9″	9½″	11¼″
Size Brake Rims	42″	46″	54″	54″	62″
	1¾″	2″	2″	2″	3⅛″
Size Drum Drive Chain	Quad	Double	Double	Triple	Triple
Number of Drum Speeds	*3	*4	6	6	6
Number of Rotary Speeds	*3	*2	3	3	
Size Line	1⅛″	1⅛″-1¼″	1¼″	1¼″-1⅜″	1½″
Length of Skids	19′	21′	22′	23′	23′6″
Weight (Less Access.)	32,000#	41,000#	54,000#	65,000#	90,000#
*Supplemented by Torque Converter Speed Ranges.					
The above specifications apply to Ideal Rig Types	55	80	100	130	10



Double drum rig with torque converter, powered by three or four diesel engines with total horsepower input of 1,050-1,230 equipped with a special rotary countershaft and gear box for either propeller shaft or standard chain table drive. Photo courtesy Ideco division, Dresser Equipment Co.

probable that within a few years hydraulic power transmission devices will be in common use.

The hydraulic torque converter is fundamentally different from the hydraulic coupling in that blades on the input pump and on the output turbine are so arranged that any slowing down of the output shaft due to extreme load conditions causes an increase in torque delivered to the driven equipment. Several types of hydraulic torque converter are now in successful operation on drilling rigs. One type has stationary blades so arranged that the torque delivered to the driven equipment varies automatically from normal torque at normal output shaft speed to five times normal torque at dead stall of the output shaft. Such torque speed characteristics are ideal for drilling rigs and the use of the above type torque converter provides smooth, shockless acceleration of the driven unit with high torque at low speeds solely by use of the engine throttle, but proper and adequate safety devices must protect all machines and tools from excessive torque input. Excessive torque on the drum shaft can part the drill pipe or the drilling line.

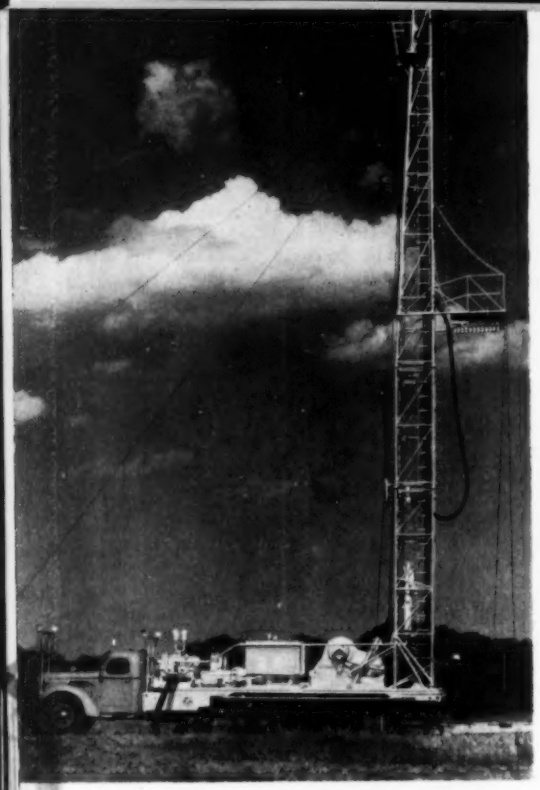
Application of the principle of torque conversion to mechanical drilling rigs is undoubtedly one of the greatest advances in design since such rigs were first placed in operation. Not only are the torque characteristics of steam power closely approximated, but an expensive multiple speed transmission is not required. Hoists that have torque converters incorporated in them have need for only two speeds forward and one reverse. The two forward speeds can be built into the hoist in the form of chain drives from the line shaft to the drum, which construction will eliminate entirely a transmission or gear box.

The operator accustomed to drilling with steam equipment who contemplates the purchase and operation of a mechanical drilling rig has many problems to consider in selecting the new type rig. The mechanical equipment is not so flexible in its application and service as is the steam rig and cannot be "stretched" as can a steam powered outfit. The internal combustion engine has definitely limited power and torque capacities and these are usually selected to provide for the normal requirements on the job in hand. An additional boiler or a superheater or a large engine will provide more power for hoisting and a larger pump will provide more fluid capacity. Also the torque characteristics of the steam engine will allow the handling of heavier loads even though at considerable reduced speeds. If more power is required for drilling to depths greater than that for which the mechanical rig was designed, the rig must be replaced with one of larger capacity or it must be rebuilt. The addition of another engine to the power plant or the substitution of a power plant of greater output will only create friction clutch trouble. Replacing the friction clutches with others of larger capacity means rebuilding the entire rig as a general rule. A somewhat similar condition will obtain when more fluid delivery is required of the mud pump. If a larger pump is installed without increasing the size of the power plant, then no increase in fluid delivery is possible. Conversely, if the power plant is increased as to output, then a pump of greater input capacity must be provided or more power will be delivered to the pump than it is designed to withstand and failure of the power end is probable.

In the selection of a power rig, there are two prime factors to consider: first, that the power pump has sufficient capacity to obtain the desired ascending mud velocity in the annular space between the drill pipe and the wall of the hole at the maximum anticipated drilling depth. To obtain the desired pump performance, it naturally requires the selection of one or more engines. If this engine or engines will be required to drive the rotary table at the same time, the rotary table's required horsepower must be added to the required pump horsepower. It is usually best to buy more engine horsepower than required for the above-stated condition. This insures longer engine life and thus effects cheaper engine operation. Second, that the hoisting speeds at the drum meet the operators' requirements. There are many other points which should be considered, such as diameter and length of the drum, to obtain good service from wire lines, braking system, shaft sizes, type of friction clutches, sprockets and chains, and the method of lubrication. All of these factors should be considered when selecting a power drawworks to give satisfactory performance and low upkeep cost.

Further problems arise when internal combustion engines are being selected for the power plant. Manufacturers commonly give them a rating that is, at best, confusing. Most engines are rated as to horsepower output when operating under ideal conditions, no deductions being made for power required to run the fan and water pump, nor for altitude, nor for type of fuel commonly available in the field. Also the rating is based on the brake horsepower delivered when the engine is new and running at its point of peak power performance, which is generally when the engine is running wide open. No internal combustion engine can be operated at top speed for extended periods of time without excessive maintenance charges: good operating practice is to use a load factor of not more than 80 per cent of the net power available. When proper deductions have been made for all the above, it is often found that the actual horsepower available for use is about 60 per cent of the rating given by some manufacturers. Field tests have shown that an engine rated by the manufacturer at 225 horsepower, when operated under conditions consistent with good practice, will provide sufficient power input to the pump to produce 100 hydraulic horsepower output. Assuming 75 per cent efficiency for the pump and pump drive, we find that the actual horsepower output of the engine is 133 horsepower or about 60 per cent of the manufacturer's rating. In view of the above, it is not surprising that many mechanical drilling rigs are underpowered rather than overpowered.

If the engines comprising the power plant are selected with due regard for the



Portable rig capable of drilling to 2,500 feet with 2⅞ inch or 4,000 feet with 2⅜ inch pipe. Two engines are compounded and may be used singly or together to drive either slush pump or drawworks and rotary. Photo courtesy George E. Failing Supply Co.

deductions above noted, then the rated horsepower available for operating the pump will undoubtedly be greater than the rated input capacity of the power end of the pump, although the net horsepower available may not be greater than the pump rating. If the net horsepower input to the pump is much greater than the pump rating, then a more ruggedly constructed pump should be provided or the engine speed should be reduced to provide less power. It should be noted that many cases are known in the field where pumps have been operated for long periods of time with an excess of power input and with no apparent ill effects. Whether this is due to the rather empirical nature of the formulae used for determining the permissible power input or whether a large factor of safety is applied to the results obtained through the use of gear formulae is not known, but the fact remains that the modern well designed power pump will operate successfully under conditions of power input that cannot be considered good operating practice, unless the ratings given are too conservative.

Brake linings are of two general types, pressed blocks and soft woven linings. There are many intermediate types of pressed woven lining. The harder the lining the longer the wear of the lining itself, but the faster the brake flange wear and the poorer the braking action. At the other extreme, the soft woven linings wear rapidly, but cause minimum wear on the brake flange and give maximum braking action. Between the two are brake linings which serve almost any purpose. The best type for all-around heavy duty service is the intermediate grade, a reasonably hard, pressed, woven lining.

The direction and method of pull of the brake bands result in maximum wear of only a small part of the lining, as the ends of the bands are in relatively slight contact with the brake flange. A so-called "engineered" set of linings which proposes to place linings of varying hardness on the same brake band so as to function in accord with the work to be done is now in general use. The theory is sound and has proved the practice will be much more satisfactory than those originally used. The metal brake band should always fully cover the lining; otherwise the brake flange or drum will be badly grooved by the lining that extends beyond the band. A greater bearing surface on the flange and a more uniform pressure of the band on the flange should be sought. Hydraulic or pneumatic control is essential for smooth and safe operation on the heaviest machines, though such controls are not now in general use.

The usual band brakes are inefficient, costly and generally unsatisfactory at best, and improvement in them is extremely important and essential for scientifically engineered hoists. There is no question but that a braking device of the so-called hydromatic or "dynamatic" type is essential on a rig engaged in deep drilling where the attempt is made to practice maximum economy, efficiency and safety.

Brake lining manufacturers are now faced with the problem of building a product that has a sufficiently high co-efficient of friction and yet will "feed off" smoothly when drilling is in progress. The two are diametrically opposed. With feed control devices in more general use better linings may be made available.

A great need of present type band brakes is for a more uniform and effective pressure throughout the contact area between the brake lining and the drum and for a larger percentage of contact.

Within the past seven or eight years the hydromatic brake has been developed and is now used generally on all jobs where heavy strings of pipe are to be handled. The larger hoists provide double brakes of this type that are clutched to the drum shaft. This "brake" is in reality an overspeed governor using hydraulic rotary pump principles. The saving in brakes effected by this device has been very substantial and a considerable safety factor is likewise built into the rig with it. The usefulness of this tool suggests the desirability of a brake attached to the drum shaft that will actually stop the load and permit the slips to be set, thus relieving the conventional band brakes of all but holding and emergency service. These brakes are now giving much more effective service on some rigs where the fluid supply to the brake is under a sufficient head to assure adequate fluid in the brake at all times.

The electric dynamic (dynamatic) brake has been developed to serve the same purpose as the hydromatic brake. This new type brake will retard the speed of the drill pipe when being lowered into the hole enough that the slips can be set without the use of the hand brake, though at some sacrifice of speed. The brake must be energized from an outside source.

Another device that serves the same purpose has been built and used successfully on several wells. It is designed on the principle of the Brantly Drilling Feed Control but uses a gear pump of much greater capacity than the multi-cylinder reciprocating pump on the Feed Control. This brake will completely stop and hold the load.

There has been much discussion among engineers concerning the advantages of a two-drum hoist over the present single-drum type. Its obvious advantages lie in cutting down the maximum speed of the drilling line to one-half the present speed of the fast line and still obtaining the same rate of travel in the elevators. It is improbable that faster speeds can be used, as we are now governed by safe hoisting rather than the capacity of the hoisting equipment. Another advantage of the two-drum hoist is that the line is in continuous movement and is doing a share of the work. Under the present single-drum system one end of the line is dead and subject to certain fatigue, while the other end is moving and subject to wear as well as fatigue. Besides, in a two drum hoist having larger braking surface than a single-drum hoist, the heat generated and the wear due to braking action are materially lessened. The two primary advantages, which are significant, are even distribution of line wear, resulting in longer and safer service, and decreased wear on brake flanges and brake rims directly proportional to the braking surface between the single-drum and the two-drum hoist. In addition, low speeds should give better service from the chains.

The disadvantages of this type of layout are in its greater cost over the other equipment; its greater weight, involving transportation difficulties; and the use of a line of exactly the right length or a longer line piled on one drum and taken over and piled onto the other drum as well is deepened. This is unquestionably bad practice and detrimental to the drilling lines. Two-drum hoists have been used in the past, but with indifferent success, probably because they were not properly designed. The machine has possibilities, though it by no means eliminates the greatest weaknesses of present day hoisting equipment. The synchronization of braking and power controls and clutches will probably present multiple difficulties.

Recognition of the fractured character of producing shale and silt beds is resulting in development of techniques which will increase recoveries greatly.

THE CONTROVERSIAL SPRABERRY

Dr. George R. Gibson spent a number of years teaching geology before engaging in the practice of his profession in the petroleum industry itself. He was instructor at his alma mater, the University of Minnesota, and subsequently professor of geology at Carleton College and Ohio State University. After leaving Ohio State, he was geologist for Socony Vacuum in Egypt before entering the West Texas-New Mexico region for Magnolia. He served Richfield as district geologist in West Texas and New Mexico and Seaboard Oil Co. as manager of exploration. He joined the consulting firm of Gibson, Leeper and Cole on Jan. 1, 1951.

By George R. Gibson

Gibson, Leeper and Cole
Geological Consultants, Midland, Texas.

JANUARY 15, 1952 saw the 1,000th Spraberry oil well completed in the Midland Basin of West Texas. The amazing part of that figure is that the drilling of that number of wells has been accomplished three years after the discovery of this highly controversial formation. It has been done with the lowest rate of dry holes drilled in any field in oil history and, in addition, this play is not one-third drilled up.

To illustrate the expanding rate of development and crude output of the Spraberry formation, one has only to look at December production figures and compare these with the total accumulated production for the past three years. The cumulative production of the entire Spraberry formation on the first of January, 1952 was 21,103,489 barrels. In the month of December, 1951 alone, the Spraberry yielded 2,021,685 barrels. This means that ten percent of the Spraberry oil thus far produced was in the month of December, 1951, and illustrates the expanding rate at which the Spraberry is being developed.

The Spraberry is phenomenal in the ratio of oil producers to dry holes drilled. Less than three percent of all wells, field and wildcat, drilled for Spraberry production were dry holes. It is true that a number of the producers are considered of low caliber; nevertheless the number of flowing wells to pumpers is high. Only ten percent of the 1,000 producing wells are on the pump. Breaking this figure down, 7½ percent of these were pumpers to start with and 2½ percent have gone on the pump after starting as flowing wells.

Most of the Spraberry wells have an allowable of 121 barrels per day for the number of producing days set by the Texas Railroad Commission each month. The allowable for all the Spraberry for the month of December was 2,400,000 barrels and production for that month was 2,021,685 barrels. The Spraberry thus is making 84 percent of its allowable. This percentage is considered high in view of the number of small outpost wells. In fields such as the Tex Harvey there is considerable variation in the percentage of the allowable made each month by the individual operators. This variation is due to the methods used in completing the wells. Each operator has his own pet method of completion. Tex Harvey, discoverer of the Tex Harvey field, has the best record thus far as his production record is 100 percent of the allowable each month. This perfect figure cannot be attributed to more favorably located acreage as his leases are scattered throughout the field. It is due to better completion practices.

The Spraberry formation is a series of interbedded shales, siltstones, limestones, dolomites and sandstones ranging in overall thickness from 900 feet to 1,500 feet. Originally the name Spraberry was applied to the upper portion of this series in a dry hole drilled on the Spraberry farm in Dawson County, Texas, by geologists of the Seaboard Oil Co. of Delaware. At present most geologists also include in the Spraberry formation all similar lithologic material as deep as the base of the Dean sand. The 900 to 1,500 feet of Spraberry formation is present only in the Midland basin, a down-warped area covering all or portions of the counties shown inside of the dash line on Figure 1. On the east and on the west rims of this basin the Spraberry formation changes into limestones and shales.

The first commercial production in the Spraberry was obtained in the Seaboard No. 2-D Lee Spraberry in Dawson County, Texas, in January, 1949 for a flowing potential of 319 barrels per day in the upper 300 feet of the Spraberry. Actually the first production, although not considered commercial, was found in Humble No. 1 Mary Turner, 60 miles to the south on the west edge of the now famous Tex Harvey field in eastern Midland County. This well has pumped a small amount of oil per day since its discovery in 1946. It was drilled

to the Devonian, which was dry, and plugged back to a point where the casing was perforated about 1,200 feet below the top of the Spraberry formation.

In January, 1949 the first commercial discovery, the Seaboard No. 2-D Lee, was followed one month later by the Tex Harvey No. 1 Floyd in eastern Midland County 54 miles south of the Dawson County discovery. The producing zone in this second discovery was approximately 600 to 800 feet below the top of the Spraberry. Thus far in three wells, if we include Humble's, three different producing zones were found. A few months later the Harry Lake No. 1 Dixon opened up the upper Spraberry in Midland County. This well was the start of a big drilling boom in Midland, Glasscock, Reagan and Upton counties, and this area is usually referred to as the Spraberry trend.

It is not just a typical Texas boast when it is said that this trend could easily merge into the largest oil field, in area, in the world. It may be some 60 miles long in a north-south direction, and from five to 20 miles wide. There would be no question concerning this distinction if production spreads northward from Midland county across Martin county and connects with the Spraberry field in Dawson county, forming an area 120 miles in a north-south direction.

The Spraberry, while expanding in areal extent, is also expanding vertically in the number of producing zones. A few months ago more than 95 percent of the oil was being produced from the uppermost 200 feet of the section; whereas now in Reagan and Upton counties, a zone near the middle (referred to as lower Spraberry) is becoming very important. At least ten zones are now producing in the 900-1,500 feet of shale, siltstone, limestones, dolomites and sands.

Oil is not all of the story of the Spraberry formation. At present the 1,000-odd oil wells are venting enormous amounts of gas. This gas will be of extreme importance in its yield of natural gasoline and liquefied petroleum products such as butane and propane. The gas in the Spraberry trend has been found to be several times as rich in liquefiable hydrocarbons as in the average Mid-Continent field. Some engineers estimate that the revenue from the gas can be 50 percent of the oil revenue.

The Spraberry is a conquest of production technique and its future depends upon new developments by the production engineers. For years geologists noted oil shows in the Spraberry section in deep wells, but these shows, upon being drill-stem tested, were considered too poor to warrant further checking. Several wells were cored and the analyses of these cores indicated the presence of some oil, but conclusively showed a lack of porosity and permeability, and thus were considered not commercial. According to the core data, this conclusion was absolutely correct; however, what was not known at that time was that open fractures in the hard durable black shale formed the oil reservoir, and not the silt or "sand." Observation of numerous cores has shown the largest fractures are not in the silt and "sand" but are present in the shale between these silt and "sand" layers.

Much evidence already existed that these fractures were present because of loss of drilling fluid during drilling and the disappearance of cement during the cementing of casing. The first observable evidence of the presence of fractures was in cores. The well would be drilled to the top of the pay, after which casing would be cemented on the outside from bottom upward. It was noticed in several wells that the cement would disappear and not come upward as it should on the outside of the casing. When the hole would be deepened later by coring after the cement had hardened, the shale cores would show these fractures filled with the lost cement. This solved the mystery of

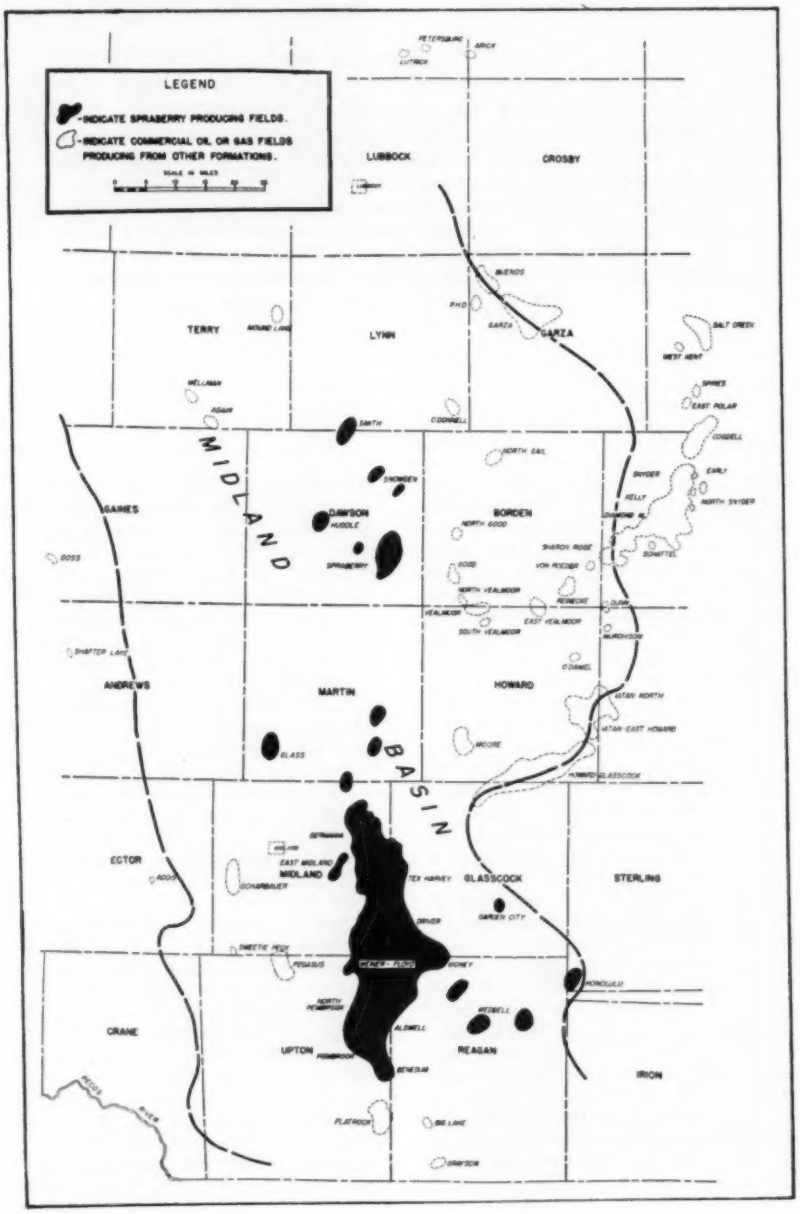


Fig. 1. Map showing vast region in which Spraberry producing fields have been developed within the past three years.

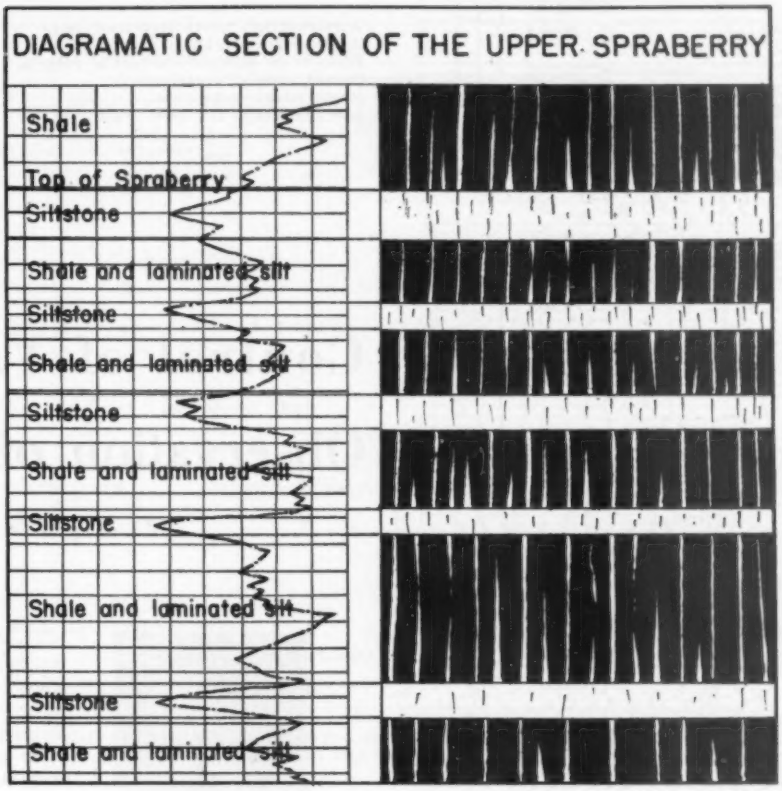


Fig. 2. Diagram indicating fractured character of the shale and laminated silt in the upper Spraberry. It is the recognition of this characteristic which is helping improve recoveries. Gamma ray curve is at left.

where this oil was coming from by proving that open fractures existed.

Much study by several large oil companies has been made on the fractures. Study has found that they are vertical and have a definite pattern. They connect vertically as much as 100 feet and horizontally as much as 1,320 feet.

One company, after figuring their pattern, tried drilling horizontally into the pay zone in order to intersect as many of these fractures as possible. The results have not been made known as yet. Another company at present is conducting experiments to determine the correct acreage spacing of wells that will most economically drain the oil out of the pay horizon. At present, wells are being drilled on 40-acre spacing, but because of the large amount of steel necessary for casing each well, some companies would like to see a well to every 80 acres.

The main reason that oil was not found in this Spraberry in some of the earlier wells was that the presence of these fractures was not known. The drilling fluid, a mixture of mud and water used to bring the rock cuttings to the surface, would penetrate into these fractures, and, due to surface tension, would block the flow of oil into the hole when a drill-stem-test was made. This not only obscured the presence of oil, but eliminated the possibility of oil ever coming to the bore hole by plugging the fractures. This difficulty was overcome by using first an oil-base mud as the drilling fluid, and later fresh oil from the nearest well. Oil was found to be the best drilling fluid because it did not adversely affect the formation and would come back ahead of the new oil when the well was brought in.

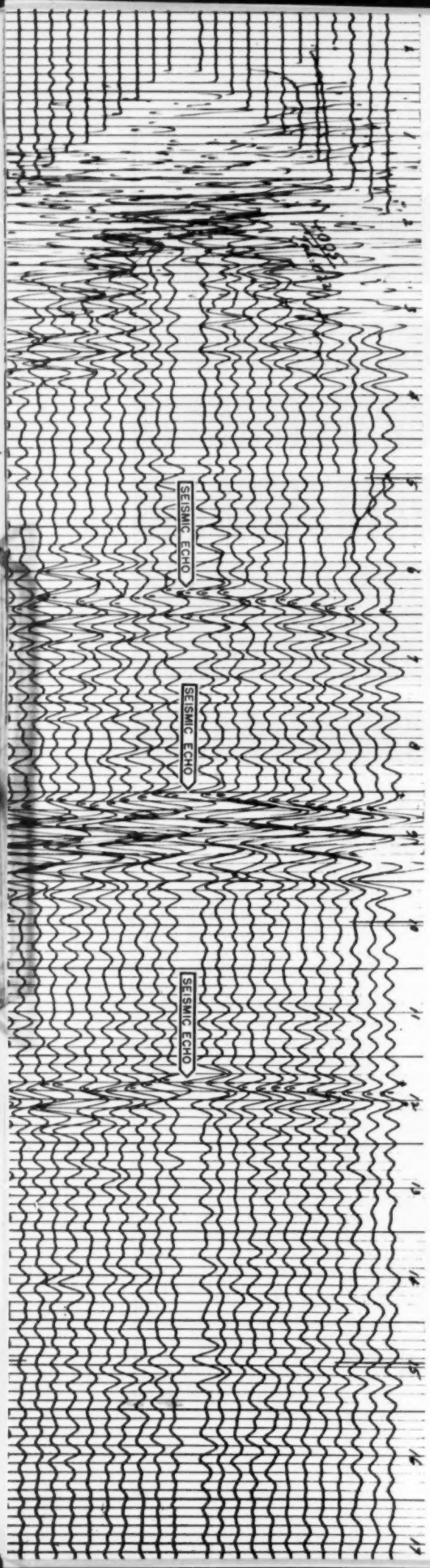
The fractures were found to contain a certain amount of loose material and became further clogged by fragments of rock during penetration by drilling. In the early wells the procedure was to shoot the hole with nitroglycerine or some other explosive in order to clean out these fractures. This necessitated a period of a week to twelve days of costly time that could be more profitably used in producing oil. Later, various fluids were injected into the hole under pressure to flush out the fractures next to the bore. The Hydrafrac and Strato-creme methods are commonly used now. This method injects a somewhat viscous gel into the fractures under high pressure after which the gel breaks down and is flushed out with kerosine or some other solvent. Originally it was thought that the injection of this fluid fractured the formation. It is generally conceded now that the injection fluid cleans out the fractures, allowing more oil to reach the bore hole. Wells can be completed by just pumping oil into the formation under high pressure. A small amount of sand in the fluid aids in scouring out the fractures.

Most of the conflicting data as to the productivity of the Spraberry has been due to lack of knowledge on the part of engineers writing evaluation reports for banks. In the first place, many engineers treated the Spraberry as a sand, when in actuality it is known by petrographic study to be a silt and has few properties of a sand. In the second place, many tried to account for the oil from their so-called sand when in reality the oil comes from fractures and most of these fractures are in the black shale between the silt beds.

Because of the two above misunderstandings, the engineers first reported the Spraberry too impermeable to produce. They were right except that fractures were not considered. One engineer who has written many reports was heard to say that he would drink all the oil over 800 barrels per acre that the Spraberry produced. He later raised that limit to 1,800 barrels per acre and will be forced to raise it again in a few months. When sufficient data is available on fractures, some accurate estimate can be made as to the recovery of the Spraberry, but until that time comes, all reports based on cores are mere guesses.

A few figures might tell you what the Spraberry has done thus far and you can make your own estimate of the future. Remember, these early wells did not have all the advantages of later completion methods. The discovery well of the Spraberry field in Dawson County has to date produced 100,000 barrels on a 40-acre tract. This gives a yield thus far of 2,500 barrels per acre. This well is still flowing. If this well flows 2,500 more barrels per acre and pumps 5,000 barrels per acre, a total ultimate recovery of 10,000 barrels per acre is possible. Later wells have had a much higher initial flow, but have not had time to prove their true worth. In the Tex Harvey field a number of wells have already flowed more than 1,200 barrels of oil per acre.

To sum up, the Spraberry is a major oil discovery. The areal extent is thus far not known, but what is known may make it the largest field in the world. In addition, the vertical or number of pays has not been ascertained, but at least ten are present. The brightest horizon is that the Spraberry is a production man's problem and new techniques will bring out of the ground more and more oil. Approximately 600,000 acres have been proven and at least that much more has possibility of producing oil. This important new discovery will add considerably to our diminishing oil reserves.



A seismograph record from an area in the Moosejaw syncline of the Williston Basin in the southeastern part of Alberta, Canada, showing a particularly strong seismic echo from near the base of the lower Cretaceous.

Control of Variables in the Observation of Seismic Echoes

By E. J. Handley

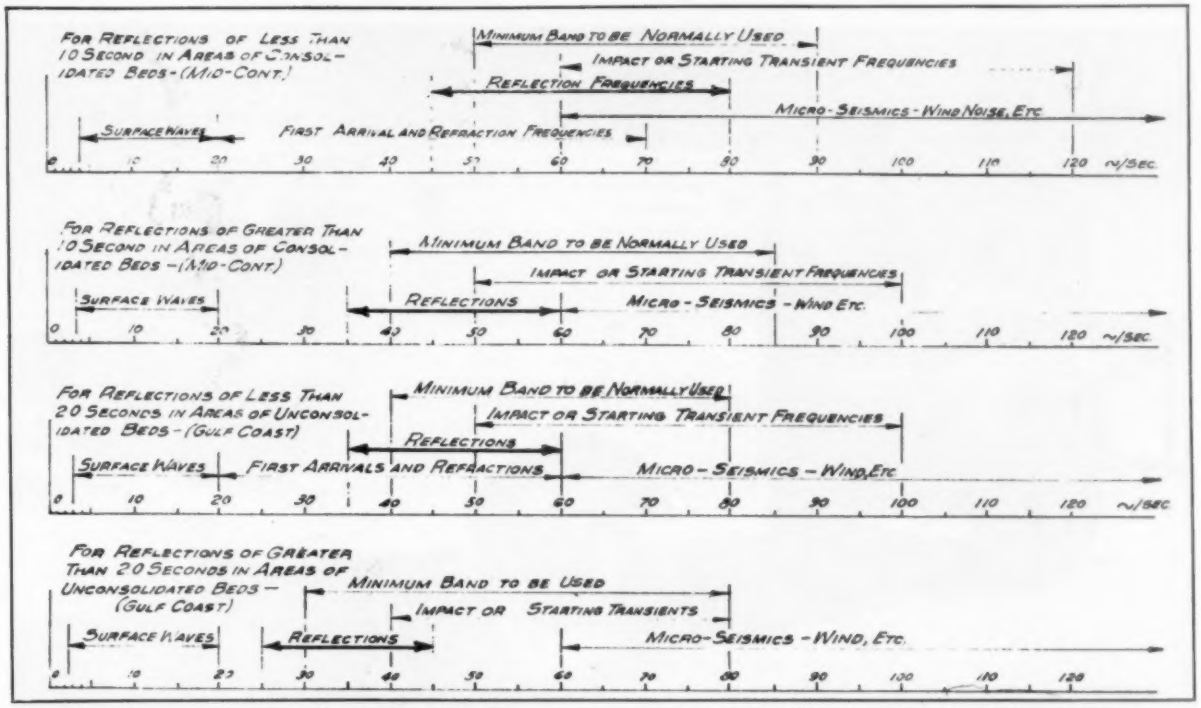
E. J. Handley has been engaged in geophysical work for the past 18-odd years. He was a party chief for Continental Oil Co. for several years and later associated with British American and Shell companies and Century Geophysical Corp. In 1950 he organized Midwestern Geophysical Laboratories at Tulsa in collaboration with M. E. Morrow, and now serves as executive vice president of Midwestern. The company manufactures geophysical equipment and does contract seismic work.

IN THE application of the seismic method in geophysical prospecting, the energy which is artificially created by an explosion is transmitted through the earth by means of various elastic wave motions. We have little control over the creation of the energy and none over its transmission. But by controlling the many variables which pertain to the technique of recording this energy we can, however, exercise considerable control over the particular wave motions we desire to observe by varying the factors to obtain optimum conditions for the observation of the energy traveling with the motion in which we are interested.

In the practical application of the seismograph in prospecting for oil, we are particularly interested in the seismic echoes reflected from various geophysical interfaces, or geological beds, and these echoes are reflected longitudinal elastic waves. The velocity of a longitudinal wave depends only on two moduli of elasticity and on the density of the medium through which the wave passes. The two moduli of elasticity of the material are those of volume and rigidity, and the velocity is a direct function of these factors.

Igneous rocks exhibit a greater seismic velocity than does shale, for although their density is greater, their elasticity is so much greater than the net result is an increase in velocity. On the other hand, coal and salt have an elasticity more comparable to shale and their decreased density results in an increased seismic velocity. Alluvium and unconsolidated formations have a low velocity because of their extremely low elasticity. It is seen that since the densities are less, that factor alone would increase the velocity. This relationship is not commonly well understood. It is not of particular importance, but it is absolutely erroneous to assume that velocities vary directly with density, whereas in fact, the velocity increases with elasticity, and decreases with density.

When dynamite is detonated in a bored hole the solid explosive turns into gas. The strength of an explosive is measured by the total energy available by the transformation per unit mass of solid into a gas. The power of the explosive is a measure of the rapidity with which the energy is made available. For seismic purposes a violent explosion is desired, since the gases


FOR REFLECTIONS OF LESS THAN 10 SECOND IN AREAS OF CONSOLIDATED BEDS - (MID-CONT.)
MINIMUM BAND TO BE NORMALLY USED
IMPACT OR STARTING TRANSIENT FREQUENCIES
REFLECTION FREQUENCIES
MICRO-SEISMICS - WIND NOISE, ETC
SURFACE WAVES
FIRST ARRIVAL AND REFRACTION FREQUENCIES
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FOR REFLECTIONS OF GREATER THAN 10 SECOND IN AREAS OF CONSOLIDATED BEDS - (MID-CONT.)
MINIMUM BAND TO BE NORMALLY USED
IMPACT OR STARTING TRANSIENT FREQUENCIES
SURFACE WAVES
REFLECTIONS
MICRO-SEISMICS - WIND ETC.
0 10 20 30 40 50 60 70 80 90 100 110 120 ~/SEC.
FOR REFLECTIONS OF LESS THAN 20 SECONDS IN AREAS OF UNCONSOLIDATED BEDS - (GULF COAST)
MINIMUM BAND TO BE NORMALLY USED
IMPACT OR STARTING TRANSIENT FREQUENCIES
REFLECTIONS
SURFACE WAVES
FIRST ARRIVALS AND REFRACTIONS
MICRO-SEISMICS - WIND, ETC.
0 10 20 30 40 50 60 70 80 90 100 110 120 ~/SEC.
FOR REFLECTIONS OF GREATER THAN 20 SECONDS IN AREAS OF UNCONSOLIDATED BEDS - (GULF COAST)
MINIMUM BAND TO BE USED
IMPACT OR STARTING TRANSIENTS
SURFACE WAVES
REFLECTIONS
MICRO-SEISMICS - WIND, ETC.

Schematic spectra of seismic frequencies indicating the presence of extraneous frequencies in addition to the seismic reflection. Although some overlapping occurs, energy traveling in waves with frequencies above and below the echo frequency can be largely filtered out.

rise to the maximum pressure in the least time. The maximum pressure may well be less than that which might be desirable for quarry blasting. The more violent explosion creates a shorter wave train and the energy traveling with various motions will be transmitted with a shorter transient past any point traversed by a wave front. Furthermore, more energy will be transmitted into the ground if the explosion is violent and is well contained. The ratio of maximum pressure to final pressure is directly proportional to the violence. When the buried and contained charge explodes, a spherical zone of pulverization is created. Consider the point of maximum diameter at the moment this zone has reached its extreme size. Material at a distance from the center of the explosion less than this radius has been subjected to strains greater than its elastic limit, because the material was broken and pulverized. Material on the surface of this maximum sphere has been strained and pushed outward, and within a short time will rebound inward, so that a point at rest prior to explosion, which in a position of rest was originally at a distance R from the center of the explosion, is pushed outward to a distance $R + \triangle R_1$. After the moment of maximum strain this point rebounds inward to a distance $R - \triangle R_2$. $\triangle R_2$ will be somewhat less than $\triangle R_1$ and although the point may then move outward past R, $\triangle R_3$ in the positive direction will be very much less than $\triangle R_1$, and the point will in this manner rather quickly come to rest at R.

This first surge and shock is the source of all energy which is transmitted into the earth by the various motions. The energy passing through the walls of the sphere of pulverization is carried into the ground at a rate depending upon the violence of the explosive. A violent explosive may therefore produce a larger zone of pulverization than a more energetic but less violent one. For a spherical wave surface, and neglecting absorption, the maximum strain passes out into the ground in the form of elastic wave motion and diminishes in amplitude in direct proportion to the distance from the point of explosion. The maximum strain, or change, in size of the sphere of unbroken material, is dependent solely upon the nature of the material and not upon the extreme size of the zone. The maximum amplitude of the seismic disturbance at a distant point is, however, a function of the rate at which the energy passes through the spherical surface into the ground, which in turn is determined by the rate at which the energy is supplied to the walls of the unbroken sphere. Seismic amplitudes therefore may be directly proportional to the radius of the zone, since energy is proportional to the square of the radius of the zone. It requires energy to fracture the rock material; if the fractured zone is very large nearly all of the energy might be used up before any is delivered in the form of wave motion. The wave energy will depend on the surface area of the fractured zone and therefore on the square of its radius, but the wave energy also depends on the square of the amplitude of the wave at this surface. The amplitude will depend on the pressure and the kind of rock. The pressure in turn should depend on the quantity and kind of explosive and should be less as the fractured zone gets greater. For a given kind of rock and given explosive, the fractured zone should increase in size with the quantity of explosive; for this case the wave energy may be proportional to the square of the radius of the fractured zone, (over practical sized zones), since the displacement is the same at the surfaces of both large and small spheres. For example, if the radius of the maximum sphere is 10 feet for a charge detonated in highly elastic shale, and one foot for a charge detonated in solid limestone or sandstone, then the maximum amplitude of the seismic motion at a distant point may be 10 times greater and the maximum energy flux may be 100 times greater for the shot detonated in a zone with a 10 foot radius, than for the shot creating a zone with a one foot radius. It is more desirable in seismic prospecting that the disturbance arrive with maximum amplitude than that the motion carry the greatest possible energy content. The most efficient explosive therefore is one of the greatest violence, detonated in the layer producing the largest zone of pulverization. This will concentrate the energy in thinner shells for

A seismograph recording truck which carries the complete set of seismic instruments.

the various wave motions and will create a more simple form of shock to be detected by the seismometers.

Motions attentuate because energy is absorbed by friction, creating heat, and by scattering. Friction losses will be greatest in sandy, loose, unconsolidated soil which will readily absorb the energy. Igneous rock will readily transmit elastic waves with comparatively little loss, but scattering may be greater because of inhomogeneities and velocity discontinuities. Scattering is greater for higher frequencies, being proportioned to the fourth power of the wave length. For example, by analogy with the propagation of light, which is an electro-magnetic wave motion rather than an elastic wave motion, we still know that the higher frequency waves of the sun's rays in the visible spectrum are scattered by the earth's atmosphere to form the blue of the sky, while the lower frequency waves are transmitted so that the sun appears to be yellow or even of reddish color. The explosion creating a seismic disturbance theoretically creates energies with all frequencies from zero to infinity, but the higher frequencies are more quickly absorbed by scattering and the predominating or average apparent frequencies are decreased as the path distance increases from the point of origin. It is probable that the apparent frequency of recorded seismic events is dependent more upon the distance from the point of origin than upon the factors concerning its excitation. It is to be noted, however, that very deep reflections do not seem to have the very low frequencies required by this generalization.

The elastic disturbances generated in seismic prospecting, like those of earthquakes, are generally caused by an impulsive shock, rather than by a continuing periodic force. Near the point of origin the disturbance is therefore a pulse and not a train of waves. At a sufficient distance from the point of origin, however, such a pulse is spread out into a train of waves. It is known, theoretically, that whatever the original form of pulse, a set of regular wave trains of different wave lengths may be found which will combine to get the form of the original pulse. A pulse traveling along a stratified formation may set the entire formation vibrating as a whole, with its natural period of oscillation. In a perfectly uniform unbounded solid, elastic waves of all wave lengths would travel with the same velocity. Under actual conditions in the ground however, the phenomenon known as dispersion may occur, which is that the velocity depends upon the wave length, with some of the energy traveling ahead of other energy and in consequence the pulse is transformed into a train of waves. Since waves of higher frequencies are more rapidly absorbed, the position in the spectrum containing the greatest concentration of energy will move to lower frequencies as the distance to the detector increases, either directly along the surface or by path length through the ground. Very shortly after the explosion, energy begins to be transmitted through the ground with various motions, having different velocities, and traveling along different paths.

When waves consisting of both longitudinal and transverse motions strike a boundary, the incident longitudinal wave creates two reflected waves; one transverse, the other longitudinal; and also two refracted waves, one transverse and the other longitudinal. The incident transverse wave does the same thing, creating both transverse and longitudinal reflected waves and transverse and longitudinal refracted waves. Furthermore, the incident longitudinal waves and the incident transverse waves may each create a Love wave, a Leet wave, and a Rayleigh wave along the formation boundary. At the surface the Love and Rayleigh waves, particularly the Rayleigh waves, create ground roll. In seismic work we are primarily interested in longitudinal waves which are transmitted as direct, refracted and reflected waves. The surface waves, probably the Rayleigh waves, have a frequency of from five to 25 cycles per second and generally travel with a velocity of from 500 to 2,000 feet per second. Refractions will generally appear to have frequencies of from 20 to 60 cycles, and reflections will generally exhibit apparent frequencies of from 30 to 80 cycles. If the near-surface soils are loose and unconsolidated, the low-velocity-layer may

be thick, and a ground roll of relatively low velocity may be created. If the surface layers are highly consolidated having a high velocity, the surface waves may become combinations of waves having high frequencies, which is typical of the "chattering" which is generally observed in limestone, sandstone, or caliche countries, being areas having an extremely thin low-velocity-layer or none at all. Micro-seisms created by ocean storms, earthquakes, and other vague sources, are of relatively low frequency, whereas wind noises created by vibrating weeds, posts, etc., are of relatively high frequency.

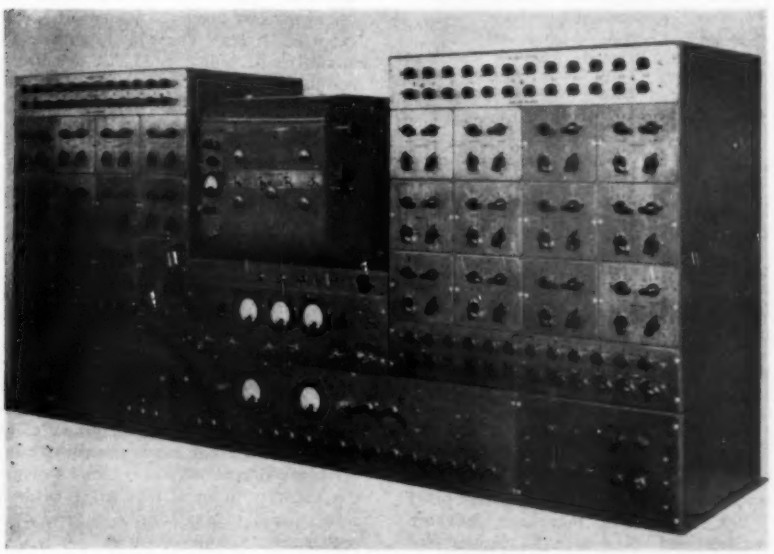
Low frequencies, fortunately, are generally rather well separated in the seismic spectrum from the seismic reflections or echoes which we desire to record. Low frequencies are, however, extremely injurious to the echoes and will easily obliterate their character, rendering them illegible and unreliable. In order to obtain the so-called "character" of the reflection wave trains, it is necessary however to admit frequencies in the spectrum somewhat higher than the upper end of the echo. In practice it is generally relatively easy to separate the echo from the low frequency surface waves. Band pass filters should be designed with a rather sharp cut off on the low frequency side. This is relatively more difficult to do as the low frequencies are relatively more difficult to handle. The bad pass filters need not cut off so sharply on the high frequency side and filters should always be used with as wide a band pass as possible, creating the least distortion and resulting in short-tailed transients and therefore better character.

When filter settings need to be changed they s h o u l d be changed drastically enough, with all other variables being held constant, so that a real effect will be apparent. As a matter of fact, most instruments do not provide for sufficiently different and radically separated filter settings. When endeavoring to obtain optimum conditions for the recording of seismic echoes, only one variable should be changed at one time, with all other variables being held constant. Charge sizes should always be as small as possible. With AVC action on the amplifiers, minimum charges cannot be determined unless charges are increased after records are first obtained which are under-shot. All surface waves, either ground roll or chatter, rapidly attenuate with distance and the most effective means, by far, of combating either low or high frequency surface waves is to off-set the seismometers away from the role.

The low-velocity-layer is necessary to insure good reception, if it is not sufficiently thick as to create ground roll or as to become a weathering problem. A wave traversing a medium in which the acoustic impedance varies will have an amplitude inversely proportional to the acoustic impedance, which is a function of velocity times density, and since in general the density increases rather slowly with depth, velocity becomes the controlling factor. Hence the lesser velocity of the low-velocity-layer decreases its acoustic impedance so that the amplitude of a wave approaching the surface from below is increased. A geophone placed in a bored hole, below the low-velocity-layer, will record greatly reduced reflection events. This property of the low-velocity-layer is noticeable in earthquake belts where structures built on alluvial fill suffer greatest damage. It is therefore necessary that geophones be placed where there is some low-velocity-layer present and not on dry clay or hard-pan, hard rock outcrops, road surfaces, or other similar material. The low-velocity-layer acts as a low-pass filter and becomes an integral part of the over-all recording system, and its effect must be considered accordingly. Geophones should of course, not be placed along fills or in stream beds where the low-velocity-layer changes abruptly or is too thick. In the early days experiments were made using sponge rubber to place under the geophones when shooting in hard rock countries, and results were considerably improved. The geophones should be firmly seated to the soil, creating an efficient bond. It is believed that only a few inches, perhaps a foot at most, of low velocity material is sufficient to create good acoustic impedance. If the soil immediately below the metal geophone is moist and firm, good bonding can be obtained between the soil and the flat interface without the use of seis-spikes.

The factors over which the operator can exercise some control are:

1. The size and type of the explosive; the depth at which it is detonated; the material opposite which it is exploded, determining the size of the zone of pulverization; the degree of confinement about the explosive, which is dependent upon the amount of water tamping and the use of complete hole plugging. It is of great practical importance to be able to change the frequencies of the various seismic disturbances by shooting at various depths in the hole. These changes may be largely determined by the various elasticity effects associated with the zone of pulverization, but there are also effects associated with the low-velocity-layer, the water table, thin laminations of hard rock beds, the earth-air boundary, and other factors. Reflections from these interfaces may reinforce the echo by means of constructive interference, and although the nature of the effect may not be well understood, shooting at various depths in a hole is one of the most effective variables under the operator's control.
2. The number of geophones in multiple set-up, and their relative spacing.
3. The total spread length covered by the geophones.
4. The use of electric mixing.
5. The location of the instrument spread from the shot hole, which is determined by the off-set distance from the hole to the first geophone.
6. The filter setting, and of course, the amount of gain and the degree of AVC and limiting action.
7. The position of the geophones and their plant. They should be located where some low-velocity-layer occurs, and should be well bonded.



A complete set of seismic instruments.

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Venezuela's Oil Economy Linked With United States

By H. J. Struth
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TIDES of fortune attending the development and growth of the Venezuelan petroleum industry have long been influenced by oil demand trends experienced in the United States. In fact, supply and demand, as well as prices of crude oil in the country, have consistently followed the patterns established by her northern neighbor during the past 14 years.

Studies of relative oil supply and demand trends in the United States and Venezuela attest the interdependence of the two countries. While Venezuela has been the world's major source of supplemental oil supplies, with markets in North America, South America, Africa and Europe, the supplemental market requirements of the United States have been the predominating factor responsible for the expansion of her petroleum industry.

Although domestic oil supplies in the United States were increased last year by about 800,000 barrels daily, the total demand exceeded supply by some 767,000 barrels daily. About 44 percent of this supplemental supply requirement consisted of residual fuel oil, while 56 percent comprised crude oil and all other petroleum products. The availability of a substantial share of such supplemental needs from Venezuela, and from refineries located on the islands of Aruba and Curacao, places particular emphasis upon the important link in the economies of both countries. This link is strengthened further by the fact that Venezuela buys about three-fourths of her commodity imports from the United States.

The direct tie-in between Venezuela's oil supply and the expanding markets of the United States is shown by an analysis of supply and demand data for the years 1938 through 1951. During this entire period, petroleum demand in the United States aggregated 26,666 million barrels, while the domestic supply amounted to 24,767 million barrels. Thus, over a period of 14 years, without any exceptions, it was necessary for the United States to import from foreign sources a total of 1,899 million barrels of oil. Residual fuel oil statistics for the corresponding period indicate a cumulative demand of 6,574 million barrels, compared with a domestic supply of 5,852 million barrels. This necessitated the importation of 722 million barrels of this product from foreign sources. Supplemental supplies of crude oil and all other products needed during this period aggregated 1,177 million barrels. A tabulation of imports by foreign sources indicates that aproximately 70 percent of the combined receipts of such supplemental supplies came from Venezuela and the refineries of Aruba and Curacao.

The following figures present a condensed summary of the supply and demand situation in the United States during the period under discussion:

U. S. Oil Supply and Demand Statistics
(Millions of barrels)

Crude & Products	Total Demand	Domestic Supply	Shortage
1938	1,331	1,268	63
1939	1,420	1,319	101
1940	1,457	1,412	45
1941	1,595	1,487	108
1942	1,567	1,472	95
1943	1,671	1,596	75
1944	1,879	1,781	98
1945	1,956	1,828	128
1946	1,946	1,851	95
1947	2,154	1,990	164
1948	2,248	2,167	81
1949	2,234	1,997	237
1950	2,483	2,154	329
1951	2,725	2,445	280
Total, 14 yrs.	26,666	24,767	1,899
Residual fuel Oil	6,574	5,852	722
Crude and Other Prod.	20,092	18,915	1,177

Due largely to the growing need for supplemental oil supplies by the United States, Venezuela's petroleum industry has been expanded to a pronounced degree within the past 12 years. Crude oil reserves have been doubled; drilling footage, crude oil production, and exports of crude and products have ascended to levels that are over 3.5 times those which prevailed during the years 1935-1939; refining operations have been expanded more than 11-fold over pre-war levels. In relationship to the base period, 1935-1939, U. S. crude production in 1951 rated an index number of 524, against 354 in Venezuela. Other comparable indices were imports, U. S. 550, Venezuela exports 357; wells drilled, U. S. 162, Venezuela 167; refinery still runs, U. S. 210, Venezuela 1,160.

Trends of production, exports and refining operations in Venezuela have shown a steady rise since 1940. The only interruptions to the upward trend were in the year 1942, when German U-boat depredations retarded export tanker movements, and in 1949, when the effects of a mild winter created an oversupply of fuel oils in the United States. Preliminary data indicates that crude oil production in 1951 was 238 percent greater than in 1940; crude exports had increased 283 percent; while refinery operations were 330 percent greater than in the year 1940. Crude oil exports in 1951 comprised about 80 percent of the country's production, compared with 70 percent exported in 1940. Venezuelan refineries processed 18.6 percent of the production in 1951, against 14.6 percent processed in 1940.

Major world markets for Venezuelan petroleum are Aruba, Curacao, the United States and Canada. About 84 percent of the oil exported moves into these primary markets. While the United States receives directly about 27 percent of the oil exported from Venezuela, substantial quantities of refined products, principally residual fuel oils, are exported to the United States from the islands of Aruba and Curacao. Together with Canada, the North American market for Venezuelan crude oil and products comprises over 60 percent of the oil which originates in that country.

While supply sources in the United States and Canada are being expanded to a marked degree, and while the Middle East is expected to occupy an increasingly important position in the oil markets of Europe and Africa, the future outlook for Venezuela favors continued expansion of supply facilities. Today, the adequacy of supply in the Western Hemisphere involves more than just producing sufficient oil to meet current requirements. It involves an urgent need to expand productive capacity to levels that will provide a safe margin of availability, beyond current needs.

Any appraisal of future requirements and prospective availability of supply con-

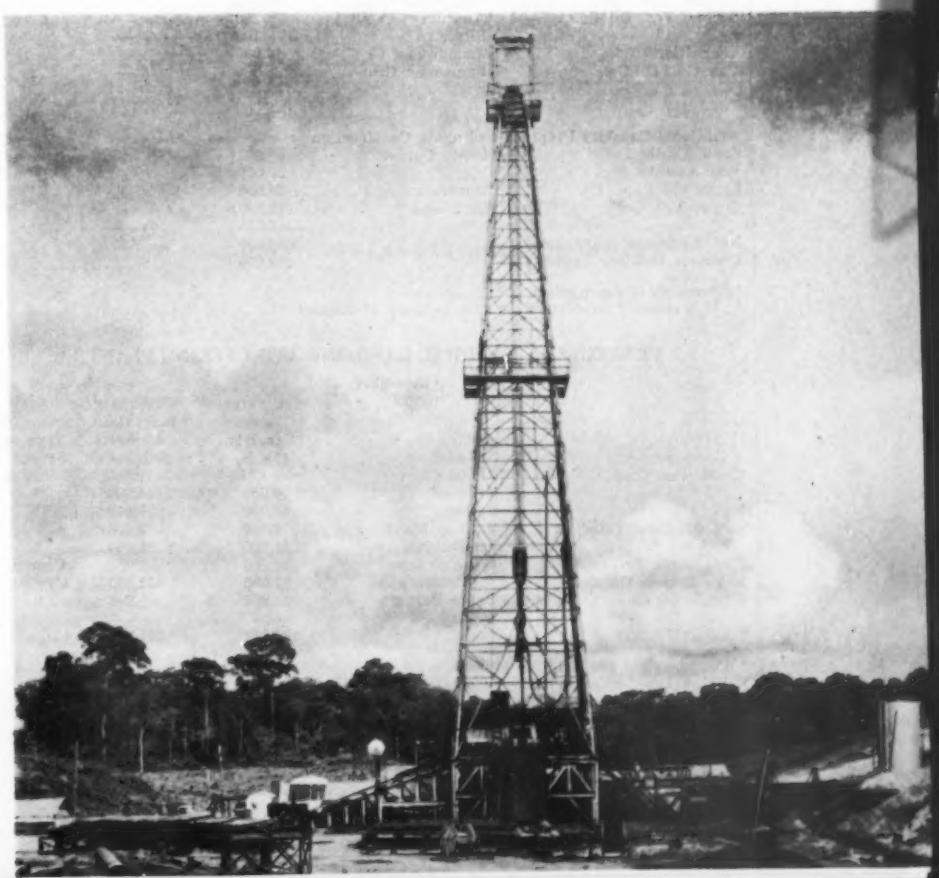
Caisson foundations which support Lake Maracaibo oil derricks are driven into the lake bed by the immense weight of concrete blocks placed on top of them. Creole photo.

firms the definite need for substantial additions to the productive capacities of the United States, Canada, and Venezuela. Even the most optimistic view of the supply outlook in North America brings the conviction that Venezuela will continue to occupy a highly important position as a source of supplemental oil supply for the United States and Canada.

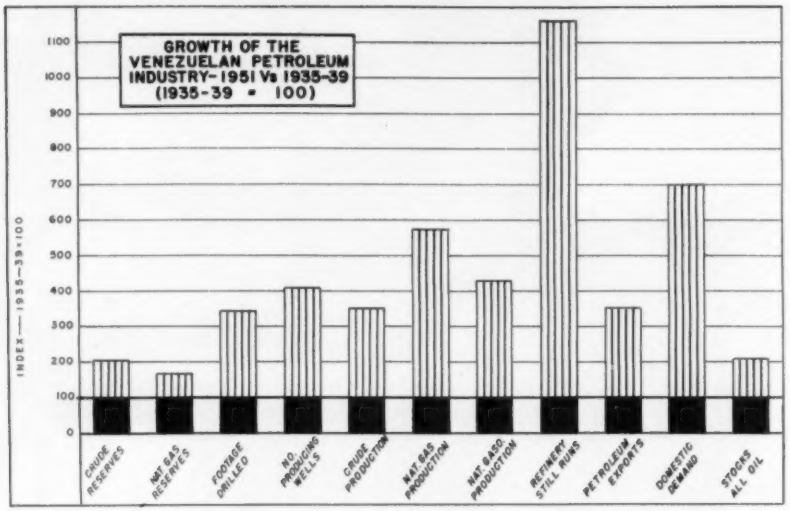
Nearly 64 percent of Venezuela's crude oil production is now being processed by refineries in the Caribbean area. Venezuelan refineries consumed about 317,000 barrels daily last year, while plants at Aruba and Curacao processed about 775,000 b/d. Other markets for crude oil were divided as follows: United States 300,000 b/d; Canada 90,000; South America, outside of Venezuela, 120,000; Europe and others, 115,000 b/d. Crude oil exports in 1951 averaged about 1,400,000 b/d, while exports of refined products averaged about 215,000 b/d. Crude oil exports comprise about 81 percent of the country's production, while refined products exports amount to about 68 percent of the oil processed in Venezuela.

Venezuela consumes less than 100,000 b/d of petroleum. There are only 96,000 motor vehicles registered in the country, of which 52,000 are passenger cars, 25,000 trucks, 17,000 station wagons, and 2,000 are buses. Nearly 40,000, or 41 percent of the vehicles in use, are in the capitol city of Caracas. Total consumption of petroleum in the country last year is estimated at about 95,000 b/d. As a result, Venezuela's surplus oil supply amounted to 1,622,000 b/d. Lack of highways into the interior regions of the country has been the main deterrent to the more widespread use of motor vehicles. Yet, domestic requirements for petroleum products have increased 217 percent since 1947, while exports rose 40 percent during the corresponding period.

While Venezuela is making remarkable progress in her industrial and social developments, it is obvious that her domestic petroleum requirements will continue for some years to comprise a relatively minor share of the productive supply. Currently the country consumes about 5.5 percent of the oil supply. Continued expansion of the country's domestic economy is likely to increase the domestic demand for petroleum by 1956 to a daily average



Alturitas 1, drilled by Creole Petroleum Corp. in hostile Indian country in the southwest Lake Maracaibo area, was the deepest hole ever drilled outside the United States when bottomed at 17,039 feet. The 250-acre location was carved out of the jungle and is brilliantly floodlighted at night as protection against Indian arrows. Creole photo.



VENEZUELAN OIL REFINERIES

December, 1951

Company	Location	Daily Crude Capacity (Bbl)	Daily Cracking Capacity (Bbl)	Type of Plant
British Contr. Oilfields	El Mene	200	—	Skim.
Colon Dev. Co. (Shell)	Casigua	1,000	—	"
"	Calvario	300	—	"
"	Rivera	300	—	"
Creole Pet. Corp.	Amuay	65,000	7,000	Compl.
"	Caripito	70,000	34,000	Skim-Cr.
"	La Salina	12,000	—	Skim.
Mene Grande Oil Co.	Oficina	400	—	"
"	Cabimas	1,800	—	"
Phillips Oil Co.	San Roque	2,000	—	"
Shell Carib. Pet. Corp.	Punta Cardon	60,000	40,000	Compl.
"	San Lorenzo	40,000	—	Skim.
Sinclair Ref. Co.	Puerto La Cruz	40,000	—	"
Socony Vac. Oil Co.	Anaco	250	—	"
"	Silvestre	100	—	"
Texas Co.	Tucupita	10,000	—	"
Ven. Gulf Oil Co.	Puerto La Cruz	35,000	—	Compl.
Total (17 Plants)		326,350	81,000	
Additional Capacity Proposed and under Construction				
Shell. Carib. Pet. Corp.	Punta Cardon	50,000	7,000	Expansion
Ven. Atlantic Ref. Co.	*	25,000	—	Skim.
Richmond Expl. Co.	Maracaibo	25,000	—	"
Creole Pet. Corp.	La Salina**	(12,000)	—	
Net Additional Capacity		88,000	7,000	
Ultimate Refining Capacity		414,350	88,000	

* Proposed, site not selected
** This refinery supplanted by new refinery at Amuay

VENEZUELAN NATURAL GASOLINE AND CYCLING PLANTS

December, 1951

Company	Location	Daily Gas Input Capacity (MCF)	Daily Gaso. Capacity (Gallons)	Type of Plant
Creole Pet. Corp.	Cumarebo	3,675	10,650	Treating
"	Jusepin	10,500	52,500	"
"	Mulata	60,000	78,000	"
Ven. Oil Conc. (Shell)	La Paz No. 1	6,700	9,400	Absorp.
"	La Paz No. 2	31,000	31,000	"
Shell Carib. Pet. Co.	Mene Grande	12,200	15,850	Compr.
Mene Grande Oil Co.	West Guara	25,000	42,300	Cycling
Sinclair Oil Co.	Santa Barbara	31,800	31,800	"
Total (8 Plants)		180,875	271,500*	

* Average yield per MCF 1.5 gallons
Estimated production in 1951—92,000,000 gallons, 252,000 gallons daily.

of more than 200,000 barrels. Thus, if present markets in Europe and Africa are lost to the Middle East, the increase in domestic requirements would offset the volumes currently exported to these areas.

Requirements in the Western Hemisphere are not expected to lessen the demand for Venezuelan oil, particularly in the light of the greatly needed expansion of productive facilities in North America. Furthermore, it is obvious that Venezuela's productive capacity must be increased substantially above present levels to meet projected market needs.

Refining operations in Venezuela have been expanded materially since 1947. Runs to stills in 1951 averaged more than 317,000 b/d, against 101,000 b/d in 1947. This amounted to an increase of 213 percent. Today, there are 17 active refineries in the country, with a daily crude capacity of more than 326,000 barrels, and a cracking capacity of about 81,000 b/d. While the Hydrocarbons Law of 1943 established a policy of refining the greatest possible quantities of crude oil produced by the country, it is believed that economic limits are being approached. Expansion of refining facilities in North America and Europe precludes any further substantial increase in Venezuela's refining facilities. The trend today is to build refineries at or near centers of consumption, and Venezuela is far removed from major oil consuming areas.

Ultimate refining capacity in Venezuela may not exceed 414,000 b/d, which may comprise about 22 percent of the country's crude oil production. Currently Venezuela is refining about 18 percent of her crude production. Only two additional refineries have been projected. The Atlantic Refining Co. has considered a plant of 25,000 barrels capacity, and Richmond Exploration Co., a Standard of California subsidiary, is also planning a refinery at Maracaibo with a daily capacity of 25,000 barrels. Shell is building more equipment at the Punta Cardon plant, which will add about 50,000 barrels a day to its capacity. Creole's plant at Amuay has supplanted the 12,000 barrel plant at La Salina. The new refinery has a rated capacity of 65,000 b/d. The ultimate addition of 100,000 b/d, less 12,000 supplanted by Amuay, places the ultimate refining capacity of the country at about 414,350 b/d.

In Venezuela the construction and operation of refineries involves the building of complete towns, including employee housing, recreational centers, clinics, hospitals, schools, churches, paved streets, sewage, electricity, gas, water and even cemeteries. In most instances, refineries in Venezuela are isolated from other cities and towns. These involve large capital expenditures, which are not usually encountered by refiners in the United States. Moreover, all of the materials and supplies used in building refineries in Venezuela must be imported, which involves heavy transportation costs.

The economic aspects of expanding refining capacity in Venezuela apply limitations beyond the immediate investment considerations. Contrary to outside belief, labor costs are higher in Venezuela than they are in the United States. This is so because the oil companies there must pay in addition to union wages, housing allowances, vacation pay, bonuses, and a share of the profits, as required by the Venezuelan labor laws. Experience has proven that it is more economical to export crude oil than it is to refine and move the products to faraway markets by water. Refining in Venezuela must necessarily be confined to the production of products needed locally and in markets adjacent to the Caribbean area.

Skimming operations predominate in Venezuela and on the islands of Aruba and Curacao, since the principal product is residual fuel oil. Caribbean plants will no doubt continue to process Venezuelan crude oils in growing volume, in response to expanding market requirements for diesel and residual fuel oils.

Venezuela is the major source of the world's heavy crude oils, which provide essential heavy products needed to supplement the light products available from crudes produced in North America. The average yield of residual fuel oil from a barrel of Venezuelan crude is about 60 per cent. Recent additions to cracking facilities in the country have increased the yield of gasoline to slightly more than 18 percent. Prior to the installation of cracking plants at Punta Cardon, Amuay and Caripito, yields of heavy fuel averaged nearly 72 percent, while gasoline recovery was less than 10 percent. In the United States, by comparison, the average yield of gasoline per barrel of crude oil is 42.9 percent, while the yield of residual fuel oil is only 18.9 percent.

The relative value of a barrel of Venezuelan crude oil, based upon wholesale prices prevailing at U. S. refineries, is now about $2.72. The average value of a barrel of U. S. crude oil at refineries is $3.69. Predominant in the recovery value of Venezuelan crude is residual fuel oil, which is worth today $1.13, compared with a yield value of that product from U. S. crudes of 36 cents. At comparable market prices, the value of gasoline in a barrel of Venezuelan crude is 87 cents, against a value in U. S. crude of $2.02.

These figures emphasize the economic advantage of Venezuelan crude oils and residual fuel oils to supplement yields obtained from average crudes in the U. S. The supply and demand statistics prove the need for supplementary, imported supplies from Venezuela. The facts make it obvious that U. S. refiners could ill afford to sacrifice the yield value available from gasoline to increase the supply of residual fuel oil.

The production and utilization of natural gasoline in Venezuela has shown a marked gain since 1948. There are eight plants in the country, with a capac-

TREND OF DOMESTIC DEMAND AND EXPORTS

Venezuelan Petroleum
(Daily Average-Barrels)

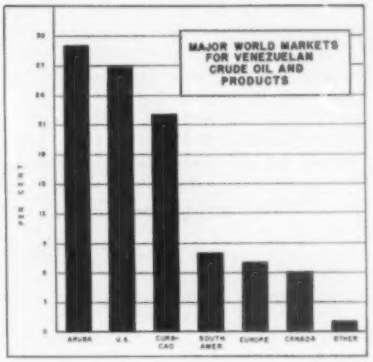
	Domestic Demand	Exports
1940	13,730	430,104
1941	13,814	605,107
1942	13,997	386,276
1943	14,608	477,427
1944	16,992	683,729
1945	19,630	869,997
1946	24,370	1,028,293
1947	29,866	1,160,726
1948	40,863	1,285,178
1949	54,013	1,258,504
1950	76,000	1,414,550
1951 (p)	95,000	1,615,000

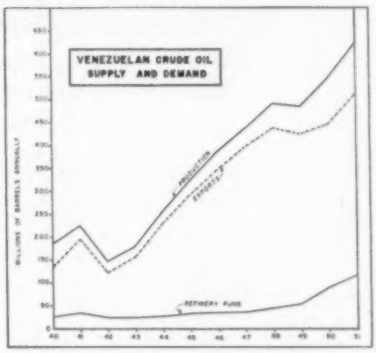
MAJOR WORLD MARKETS FOR VENEZUELAN PETROLEUM

Year 1951 (p)

Destination	Percent of Total Exports
Aruba	29
United States	27
Curacao	22
South America	8
Europe	7
Canada	6
Other	1
Total	100

Total oil exported in 1951: 589,475,000 barrels, of which 510,000,000 was crude oil and 79,000,000 was refined products.
(p) Preliminary estimates





REFINERY YIELD VALUES OF CRUDE OIL

Venezuelan and United States Crudes

(Prices based upon average U. S. refinery markets)

	VENEZUELAN CRUDES			UNITED STATES CRUDES		
	Gallons per Bbl.	Price per gal.	Total Value	Gallons per Bbl.	Price per Gal.	Total Value
Gasoline	7.7	$.1125	$.87	18.0	$.1125	$2.02
Kerosine	1.1	.0950	.10	2.4	.0950	.23
Distillates	6.5	.0850	.55	8.4	.0850	.71
Residual Fuel	25.2	.0450	1.13	7.9	.0450	.36
Other Prods.	0.8	.0850	.07	4.4	.0850	.37
Total	41.3	.0658	$2.72	41.1	.0897	$3.69
Loss	.7			.9		
Total	42.0			42.0		

GROWTH OF THE VENEZUELAN PETROLEUM INDUSTRY

	1935-39 Average	Year 1951 (p)	Index (1935-39 -100)
Crude Oil Reserves (Bill. Bbl.)	4,500	9,100	202
Nat. Gas Reserves (Bill. Cu. Ft.)	9,500	15,500	163
Wells Drilled	404	675	167
Footage Drilled (Thous. Ft.)	1,100	3,800	345
No. Prod. Oil and Gas Wells	1,750	7,200	411
Crude Production (Mill. Bbl.)	176	623	354
Nat. Gas Production (Bill. Cu. Ft.)	100	575	575
Refinery Runs (Mill. Bbl.)	10	116	1,160
Petroleum Exports (Mill. Bbl.)	165	589	357
Domestic Demand (Mill. Bbl.)	5	35	700
Stocks, All Oil (Mill. Bbl.)	9	19	211

(p) Preliminary estimates.

APPROXIMATE BREAKDOWN OF GAS UTILIZATION

(Preliminary Estimate, 1951)

Natural Gas Processed	61,350,000 MCF	10.6%
Utilization	42,300,000 MCF	7.3%
Repressuring-Gas Lift	40,000,000 "	7.0%
Used as fuel and sold	492,700,000 "	85.7%
Blown to atmosphere		
Total Gas Produced	575,000,000 MCF	100.0%

ity of about 271,500 gallons daily. Production in 1948 averaged about 74,000 gallons daily. Last year, these plants processed more than 61 billion cubic feet of gas, which comprised about 10.6 percent of the total produced. The average yield of liquids per thousand cubic feet is about 1.5 gallons. Lack of markets for natural gas results in a deplorable waste, through the release into the atmosphere of more than 85 percent of the natural gas produced. Preliminary data indicates that 7.3 percent of the gas produced was used for repressuring and gas lift, while about seven percent was consumed as fuel and sold. Estimates place the total production of natural gas in Venezuela last year at approximately 575 billion cubic feet, of which nearly 493 billion cubic feet was flared.

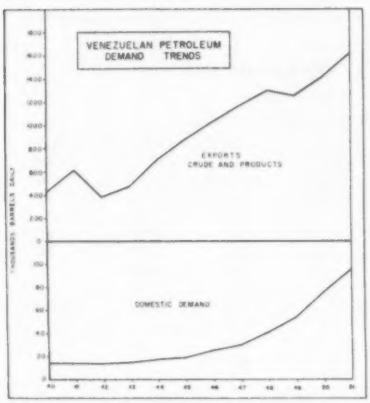
TRENDS IN VENEZUELAN CRUDE OIL

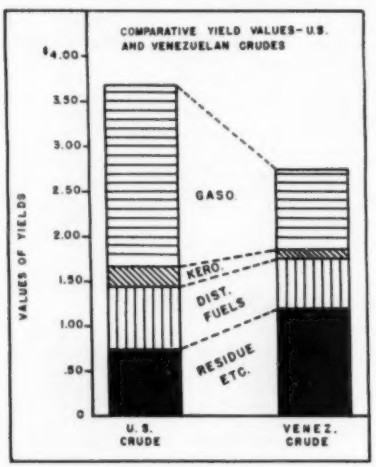
SUPPLY AND DEMAND

(Millions of Barrels)

	Crude Production	Crude Exports	Refinery Still Runs
1940	184	133	27
1941	227	194	32
1942	148	121	23
1943	179	156	22
1944	257	230	26
1945	323	291	33
1946	388	348	35
1947	435	397	37
1948	490	439	44
1949	482	422	53
1950	547	448	90
1951 (p)	623	510	116
Percent Increase			
1951 Vs 1940	238	283	330
1951 Vs 1946	93	75	251

(p) Preliminary estimates.





Transportation presents no immediate problem in Venezuela. Existing facilities are more than adequate to handle a substantially increased volume of oil above current needs. There are 1,412 miles of crude oil pipe lines and 93 miles of products lines in operation. These lines have a combined daily capacity of about 2,686,000 barrels. Pipe line movements of oil in 1951 aggregated about 1,535,000 barrels, which comprised 57 percent of the maximum capacity. Creole, Shell and Mene Grande oil companies own and operate 1,097 miles of lines, or 73 percent of the total mileage. About 90 percent of all oil produced in Venezuela is moved by pipe lines.

Marine transportation facilities are more than adequate to handle present and prospective volumes of oil in local and export movements. Tankers are divided into two classes: shallow draft and ocean tankers. A total of 96 shallow draft tankers are employed in moving oil in the Lake Maracaibo area, which have a combined loading capacity of 2,817,000 barrels. These range in size from 6,000 to 60,000 barrels each. Ocean tankers, owned by private shipping companies, range in size from 80,000 barrels to super tankers having a capacity of 250,000 barrels. Coastwise and export movements of oil are facilitated through 24 shipping terminals, of which four are on the coast of eastern Venezuela (Pedernales and Puerto La Cruz), two are on the Paraguana Peninsula, and 15 are located along the shores of Lake Maracaibo.

Consideration of existing facilities in relationship with the probable trend of supply requirements over the next five years, places particular emphasis upon the need for greater crude oil availability. The facts prove that this is the only branch of the industry in Venezuela which has failed to maintain the pace of economic developments. All other branches of the country's petroleum industry have been expanded to meet future requirements. There is adequate refining capacity to provide the product needs of today and tomorrow, within the limits dictated by economic considerations. There are no transportation bottle-necks in the foreseeable future, since existing facilities are more than adequate to handle far greater volumes of oil. But, as was pointed out in the February issue of WORLD PETROLEUM, there is a serious inadequacy, a far too narrow margin, in the productive capacity of crude oil.

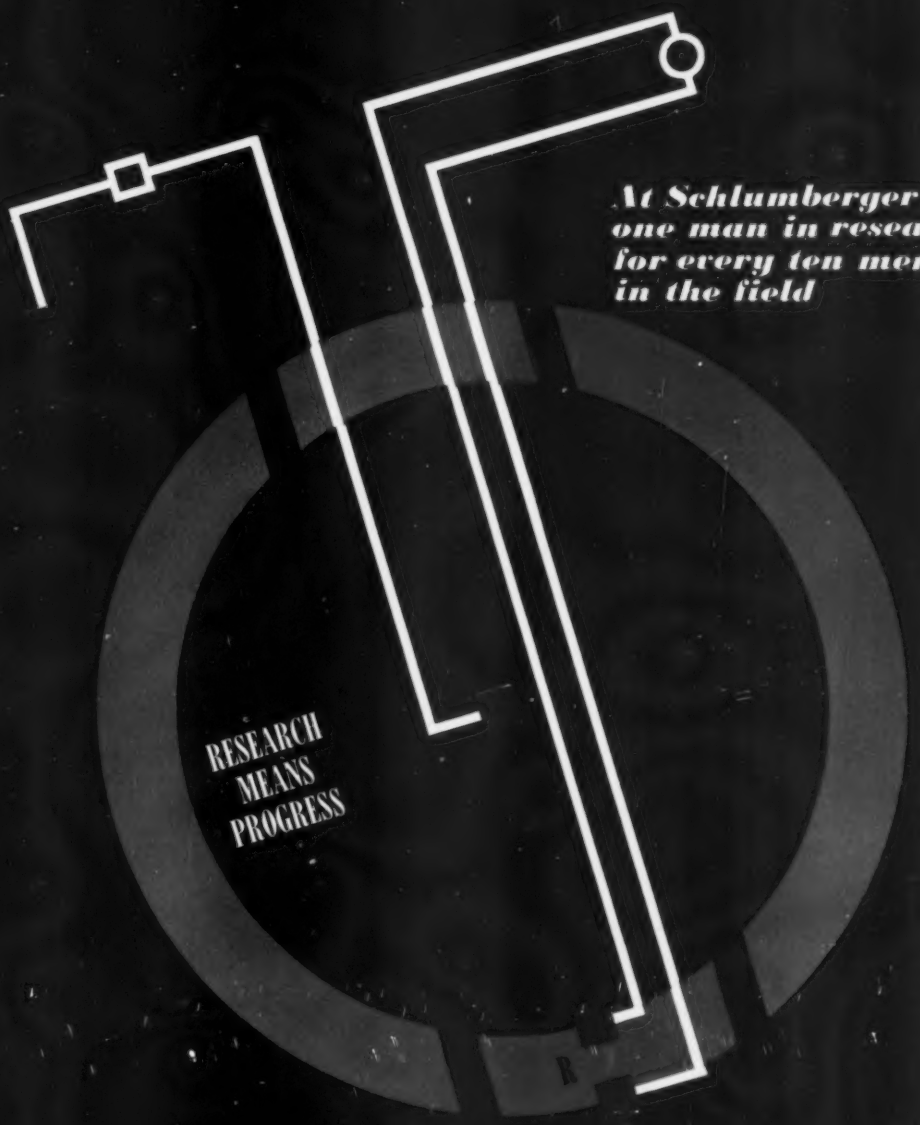
In the light of past experience, which

(Please turn to page 84)

VENEZUELAN DISCOVERIES SINCE 1913

Year	Field	State	Company
1913	Guanoco	Sucre	Bermudez
1914	Mene Grande	Zulia	Shell
	Totumo	"	"
1915	Rio de Oro	"	Creole
1916	Las Cruces	"	Shell
1917	La Rosa-Cabimas	"	"
1921	El Mene de Mauroa	Falcon	BCO
1925	Pauji	Zulia	New Eng. Oil
	La Concepcion	"	Shell
	La Paz	"	"
1926	Lagunillas	"	Mene Grande
	Monte Claro	Falcon	Creole
1927	Los Manueles	Zulia	Shell
	Hombre Pintado	Falcon	BCO
	El Mene de Acosta	"	No. Venez. Pet.
1928	Tia Juana	Zulia	Creole
	Amana	"	Mene Grande
	Las Palmas	Falcon	Creole
	Quiriquire	Monagas	"
1929	Netick	Zulia	Orinoco
1930	Bachaquero	"	Mene Grande
1931	El Mamon	Falcon	Richmond
	Cumarebo	"	Creole
1932	Media	"	BCO
1933	Pedernales	Delta Amacuro	Creole
	Orocual	Monagas	"
	Oficina	Anzoategui	Mene Grande
1936	Temblador	Delta Amacuro	Creole
	Santa Ana	Anzoategui	Mene Grande
1937	Pilon	Delta Amacuro	Creole
	Uracoa	" "	"
	Merey	Anzoategui	Mene Grande
	Areo	"	" "
	Yopales	"	" "
1938	Pueblo Viejo	Zulia	Shell
	Jusepin	Monagas	Creole
	Leona	Anzoategui	Mene Grande
1939	El Roble	"	Creole
	San Joaquin	"	Creole
1940	Los Caritos	Delta Amacuro	Texas Co.
	Socorroro	Anzoategui	Creole
1941	Santa Rosa	"	Mene Grande
	Las Mercedes	Guarico	Las Mercedes
1942	Quiamare	Anzoategui	Mene Grande
	Las Ollas	Guarico	Creole
1943	San Ignacio	Zulia	Shell
	Agua Clara	Anzoategui	Mene Grande
1945	Mara	Zulia	Shell
	Tucupita	Delta Amacuro	Texas Co.
	Capacho	Anzoategui	Creole
	Nipa, West	"	Mene Grande
	Moquete	"	" "
1946	Boscan	Zulia	Richmond
	Ensenada	"	"
	Macoa	"	"
	La Ceiba	Anzoategui	Mene Grande
	Nipa, East	"	" "
	Caico Seco	"	" "
	Tucupido	Guarico	Atlantic
	Palacio	"	Las Mercedes
	Grico	"	" "
1947	West Tarra	Zulia	Shell
	Antonio	Anzoategui	Mene Grande
	Fria	"	" "
	Pelayo	"	Atlantic
	Pelas	"	"
	Lechoso	Guarico	Creole
	Saban	"	Atlantic
1948	Sibucara	Zulia	Shell
	Albaricos	"	Richmond
	San Jose	"	"
	Silvestre	Barinas	Socony Vac.
	Aragua	Monagas	Creole
	Toco	Anzoategui	Mene Grande
	Chimire	"	Socony Vac.
	Inca	"	Mene Grande
	Guavinita	Guarico	Las Mercedes
1949	Abundancia	Falcon	Creole
	Silvan	Barinas	Socony Vac.
	San Roque	Anzoategui	Phillips
	Cachicamo	"	Atlantic
	Mapiri	"	Mene Grande
	Soto	"	" "
	Freites	"	Creole
	Ruiz	Guarico	Atlantic
	Piragua	"	Las Mercedes
1950	Alturitas	Zulia	Creole
	La Vieja	Anzoategui	Mene Grande
	Dacion	"	" "
	Los Mangos	"	" "
	Tagua	"	" "
	Guere	"	Sinclair
	Barbacoas	Guarico	Atlantic
1951	Cerro Pelado	Anzoategui	Mene Grande
	Chaparro	"	" "
	Chive	"	" "
	Boca	"	" "
	East Soto	"	" "
	No. San Tome	"	" "
	Cocomon	Guarico	Atlantic
	Monal	"	"
	No. Palacio	"	Las Mercedes

SCHLUMBERGER RESEARCH...



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DENVER-JULESBURG BASIN

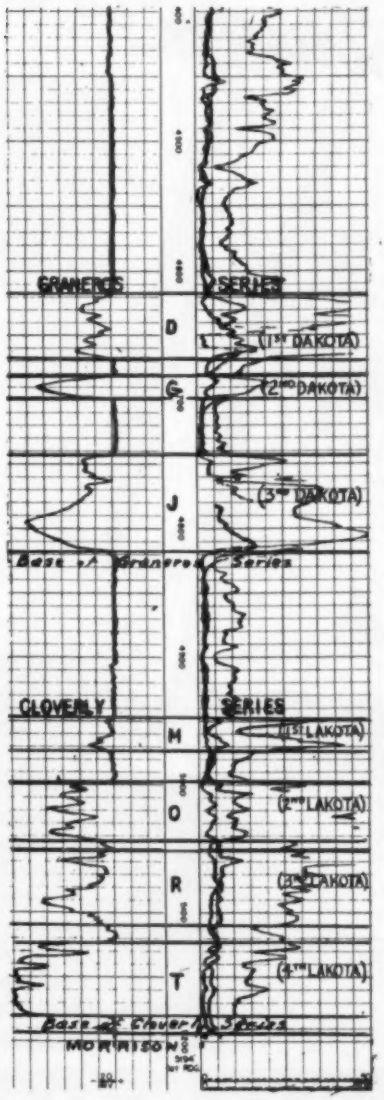
By Maury Goodin
Co-Owner Petroleum Information, Denver-Casper

THE most active oil area in the Rocky Mountain region during the past year, and the one with the brightest future, is the Denver-Julesburg basin of northeastern Colorado and southwestern Nebraska. A total of 28 new discoveries was made in this basin in 1951, out of 227 wildcats drilled. The area is typical of a number of areas in the Rocky Mountains, in that oil was found in the basin a number of years ago, but there has been no serious concentration on exploration in the area until recent new discoveries.

Improvements in exploration methods are credited with a part of the success in the area, as the majority of discoveries are based on seismic work. Leasing and exploratory drilling in the area will continue active for a number of years, with new pools presently extending over a distance of more than 100 miles in a north-south direction. New discoveries are being made weekly, and the wildcat program is continuing at a rapid pace this winter.

One feature of considerable importance to the area is the shallow depth and comparative low cost for exploratory and development drilling. This has resulted in an influx of individuals and independent operators who have never been active in the Rocky Mountains. A large part of Rocky Mountain production is costly to drill and located on very sizeable lease holdings, with the result that independent operators have looked to more flexible oil areas for operation. The Denver-Julesburg basin, largely composed of fee land holdings, offers this flexibility to these individuals and operators with the result that they are playing an important part in development and exploration.

The Denver-Julesburg basin extends more than 400 miles north and south and approximately 250 miles east and west, with the Rocky Mountain range as the west boundary, the Hartville uplift in east central Wyoming and the Chadron arch of north-central Nebraska forming the north and eastern borders, and the Las Animas arch of southeastern Colorado the southern border. The deeper portion of the basin lies immediately east of Denver, extending northward to the Cheyenne, Wyo., area. A large part of the basin is covered with Tertiary beds, making early geologic work difficult.



Logs of the Ohio Oil Company's Well No. 1 Cruise in the Huntsman Area, Cheyenne County, Nebraska. The field produces oil and gas from the D sand at 4,600 and gas from the J sand at 4,750 feet.

The first discovery in the basin, and in the Rocky Mountains, was made at Florence, Colo., west of Pueblo, in 1863 when oil was found in Pierre shale. This field has produced more than 14 million barrels of oil since that time and is still producing. Some time after this discovery, oil was found at Boulder, and later at Fort Collins and Wellington fields, all along the west flank of the basin. More recently production has been established at Horse Creek and Borie, near Cheyenne, Wyo. All of the more recent fields produce from the Dakota-Lakota (lower Cretaceous).

In 1930 an active play developed in northeastern Colorado following discovery of oil in the muddy sand at Greasewood field, eastern Weld County. However, only a few of the wells produced oil and the field had made only 500,000 barrels prior to recent new completions. As a result of this discovery a number of wildcats were drilled, with no successful completions, and activity died within a two-year period. The majority of the wildcats were drilled after surface work on Tertiary beds.

In 1936 another active lease play developed through east-central Colorado, along the Las Animas arch, and the southwest flank of the arch. Several tests were drilled and oil shows were found in Pennsylvanian beds by at least two of these wells, but no commercial wells resulted and the exploratory play had dwindled by 1940. One of these wells, the Gulf Oil Corp. No. 1 Larsen-U.P.R.R., C SE NW 13-13S-49W, in the Kit Carson area, Cheyenne County, Colo., caused considerable interest following the recovery of oil on tests in the Pennsylvanian in 1938. However, the operator spent considerable time in testing, without result. This same portion of the basin is now the scene of additional drilling and seismic work.

As early as 1934 the Ohio Oil Co. did magnetometer work through western Nebraska, and this work was followed by spasmodic exploration, but no drilling, in the area. In the early 1940's Sinclair Oil and Gas Co. conducted an extensive lease play through central and western Nebraska, and followed with a series of dry holes through the area. By 1944 there was

(Please turn to page 79)

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little activity in this part of the Rocky Mountains. Development drilling had long been completed in the majority of fields along the west flank of the basin, and there had been no wildcat drilling through the basin. Ohio started on a seismic program in the Greeley area of central Weld county and drilled a dry hole failure, followed by two in which Tide Water Associated joined, in the deeper portion of the basin. In 1946, Ohio did some geophysical work through southwestern Nebraska, but it was not until 1948 that the company acquired leases through the area.

A large rather loose lease block was taken by Ohio in 1948, and early in 1949 the company started drilling at No. 1 Egging, NE NE NE 11-15N-49W, in the Gurley area, Cheyenne county. A heavy rig was moved on the prospect, which was planned as a test to granite. However, oil was recovered on tests of the First Dakota (D sand) at 4,401 feet and the well was completed in that formation as the first commercial discovery in western Nebraska. The well had an initial of 225 b/d of 36 API gravity oil on pump.

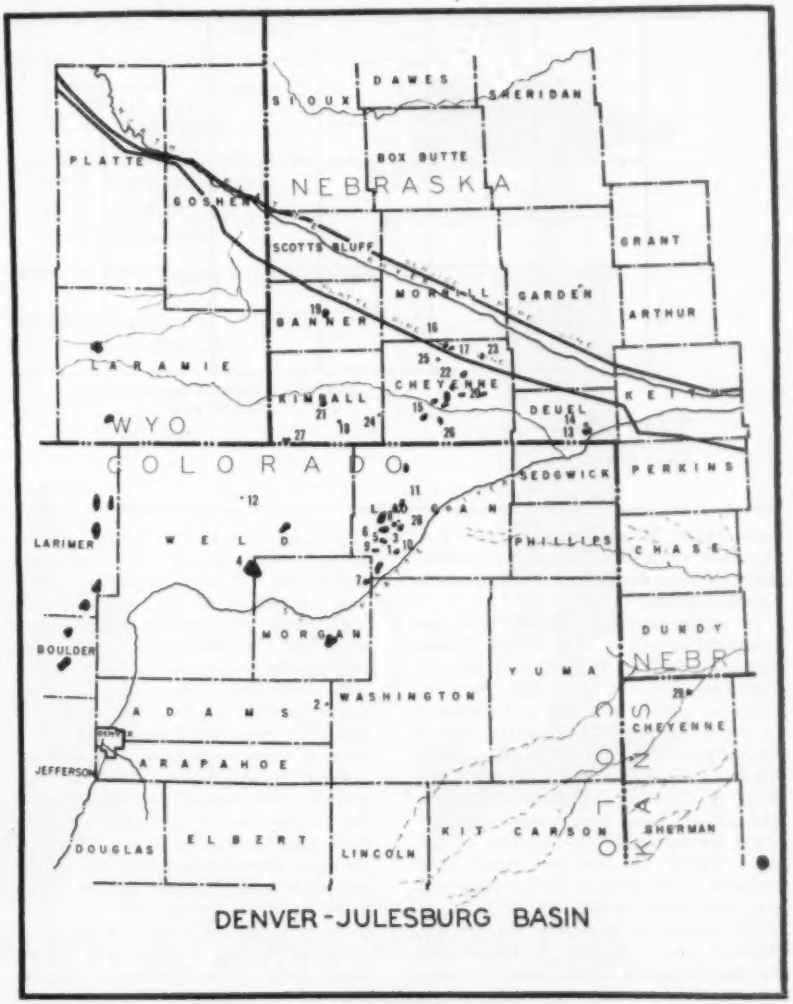
Discovery of oil at Gurley immediately led to a lease campaign, not only by Ohio, but by several major operators of the region. However, it was not until the discovery of oil in Logan county, Colo., and further development drilling in fields of both Colorado and Nebraska that the play demanded the large attention that it now has. The producing formations were considered thin, as compared to most Rocky Mountain reservoirs. Initial production on some of the earlier competitions were not particularly large. At Gurley, Ohio drilled four dry holes, and although nine producing oil wells were completed, proving approximately 240 acres, the initial discovery was not credited with the importance it presently holds.

Leasing extended throughout Cheyenne county, Neb., with Ohio easily leading in lease acquisition. Superior Oil Co. followed closely with checkerboard and some solid lease blocks through Morrill, Garden and Deuel counties. Across the line in Colorado, Plains Exploration Co. acquired approximately 250,000 acres of leases through northwestern Logan county and started a wildcat drilling program. Following the third failure, the company negotiated with British American Oil Producing Co. for a seismic program by the latter on this lease spread. At about this time other operators started acquiring lease interests throughout the entire basin of Colorado and Nebraska. Heavy lease holders include Stanolind Oil and Gas Co. (with estimated holdings in the basin of around three million acres), Shell Oil Co., The Texas Co., Sinclair, Union Oil Co. of Calif., Carter Oil Co., Amerada Petroleum Corp. and Phillips Petroleum Co., as well as the operators previously mentioned. Present estimates of lease holdings through the basin are as high as 15 million acres. A large portion of this is held by independent operators.

Lease blocking has extended across the rim of the Las Animas arch, on the south and southeast, and into the northern portion of the Anadarko basin. On the east, lease holdings extend across the Las Animas arch and into western Kansas. A lease play has also extended northward from central Kansas into south-central Nebraska, following new discoveries along the Kansas-Nebraska state line during the past year. There is heavy leasing across the Chadron arch of central Nebraska, which borders the Denver-Julesburg basin on the northeast. All of these areas are prospective for heavy exploration operations during the coming years.

Following new discoveries moving westward into Weld, Morgan and Adams counties, Colo., in the deeper portion of the Denver-Julesburg basin, the leasing has been heavy in this area during the past year. Although the southeastern Wyoming area has not been too successful from the standpoint of new drilling and new discoveries, leasing has been active and it is expected that there will be much more drilling in this area during 1952.

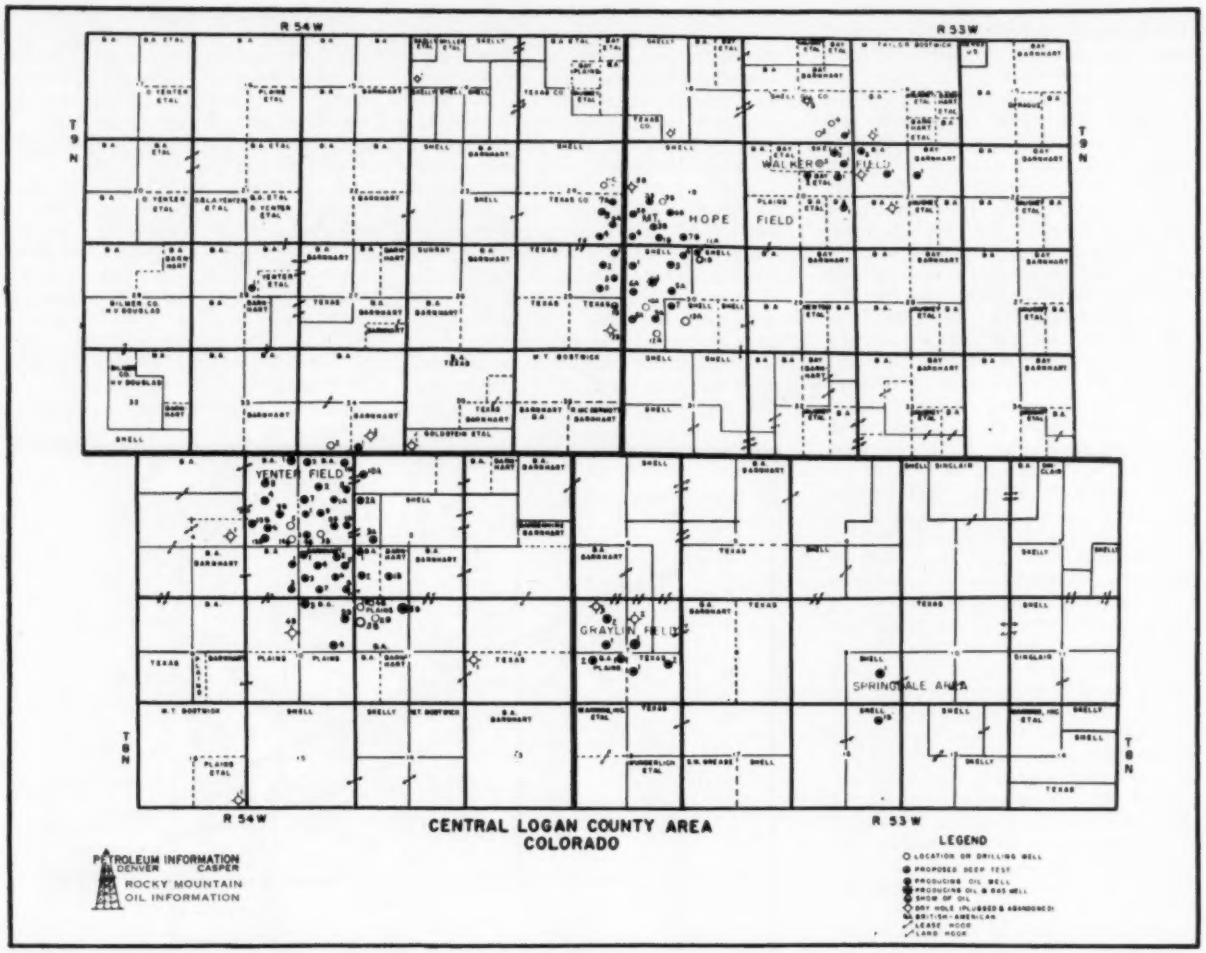
In June, 1950, British American made the first discovery in the current play on the Colorado side of the basin, and this discovery probably did more to accelerate leasing than any other. The pool was named Armstrong and both oil and gas were found from the D and J sands at 5,275 and 5,400 feet. Development drilling proved the producing area to be small. This discovery was followed quickly by discoveries at Merino, Morgan, Bucking-



1951 DISCOVERIES

1 Atwood (O)
2 Little Beaver Creek (G)
3 Graylin (O)
4 Greasewood (O)
5 Hoover (O)
6 Logan (O)
7 Mesmer (O)
8 Padroni (G)
9 Sand Creek (O)
10 Springdale Area (O & G) '51
11 Walker (O)
12 Keota (O) '52
13 Big Springs Area (G)
14 West Big Springs (G)
15 East Brownson Area (O)
16 Dalton (O)
17 Southeast Dalton (O)
18 Enders (O)
19 Harrisburg (O)
20 Johnson Area (O)
21 Kimball (O)
22 Marlowe Area (O)
23 McCourt Area (O)
24 Southwest Potter (O)
25 Reimer (O)
26 West Sidney (G)
27 Sisson Area (O)
28 Springdale (O) '52
29 Ben F. Brack (O)

O—oil G—gas



ham, Walker, Mount Hope and Yenter during 1950, and a large part of the development drilling during 1951 was in these Colorado fields.

In southwestern Nebraska, Ohio has continued to lead in both wildcat and development drilling. This company now has eight separate oil and gas pools in Cheyenne county and one gas discovery in Deuel county. Gulf, Stanolind, Wytex Petroleum—Derby Oil Co., Brown Drilling Co., C. D. Edmonson, H. P. Macauley, Recco Oil, Midwest Oil, Nebraska Drillers and others have been responsible for other discoveries in this portion of the basin during the past two years. The majority of discoveries in the Nebraska area were made during 1951.

All production from the current exploratory area of the basin has been from the Dakota-Lakota series sands of Cretaceous age. An exception is the Ben Brack Oil Co. small Pennsylvania discovery located in Cheyenne county, Kan., along the northwest flank of the Las Animas arch. The First Dakota, or D sand, has a thickness of approximately 55 feet, followed by a shale break of ten to fifteen feet. The First Dakota is one of the principal producers in the Basin. Only two pools have production from the Second Dakota, or "G" sand, which has a thickness of around 35 feet, followed by a shale break of approximately the same thickness. The Third Dakota, or "J" sand, is presently the leading producing formation of the area. Some shows have been found in the Lakota series sands, immediately below the Dakota, and four or more of these sands have been identified.

From present drilling it now appears probable that some of the fields through the general "trend" areas developed will have small producing areas. Several of the pools presently have only two or three producers with an equal number of dry holes. However, several wells have rated flows in excess of 1,000 barrels of oil daily, particularly in the Yenter-Mount Hope pools. The Huntsman, Dorman, Yenter, Mount Hope, Merino and Gurley pools are among those that will apparently be fairly sizeable. The majority of producing wells have completion potentials in the neighborhood of 250 barrels of oil daily. Permeabilities are higher than in most Rocky Mountain provinces, ranging from 150 to 450 millidarcys. Porosity varies from 17 to 23 per cent in the D and J sands.

Drilling throughout the entire basin is inexpensive and a number of wells have been completed under surface casing in ten days time. There has been little lost circulation difficulty. The majority of the wells in the Gurley-Merino trend have been drilled for less than $30,000. During 1951 as many as 65 rotary rigs were drilling in the basin, and apparently this activity will be increased during the coming year. In completion of the producers a number of the operators cement casing through the D or J sands, to selectively perforate the producing zone. Some of the pools have difficult water problems.

In Cheyenne county, Neb., the Huntsman pool has been one of the most active and interesting. Ohio made this discovery as the second in western Nebraska in December 1949. The field produces oil and gas from the D sand at around 4,600 feet and gas from the J sand at 4,750 feet. Twenty-five oil wells and seven gas wells have been completed in the field, making it the largest in the Nebraska portion of the basin. The field is presently defined as to producing area, and Ohio has

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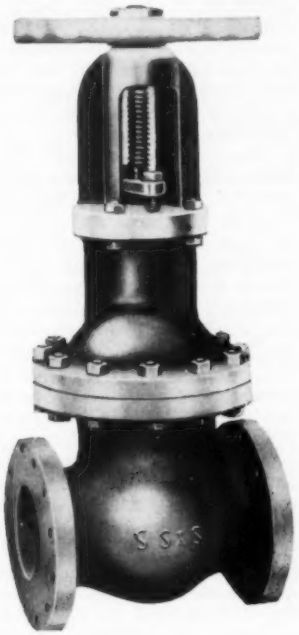

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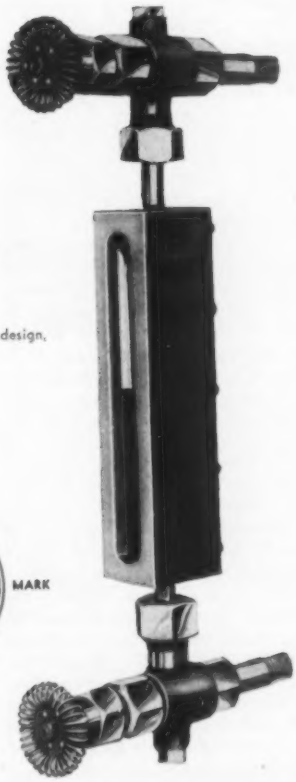

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unitized the gas (J sand) area for the first unitized field in the basin.

The Dorman pool in Sec. 23-14N-50W, immediately south of Huntsman, was discovered in July 1950 by Ginther-Warren-Ginther of Houston and may have the highest recovery per acre of any pool in the area. The field produces oil from both the D sand at 4,690 feet and the J sand at 4,800 feet. Sixteen wells have been completed, and additional drilling is underway.

Nebraska Drillers of Ogallala made the first discovery in Kimball county, west of previous production, with completion of No. 1 Torgeson, SE NW NW 23-14N-56W, in the Kimball area. The well was completed for an initial of 150 barrels of oil daily from the J sand at 6,506 feet. This discovery was followed by several smaller producers, but did have the effect of moving the activity westward into the deeper portion of the basin. During 1951 Gulf followed with a discovery at Sisson, Sec. 18-12N-58W, where J sand production was found at 7,330 feet.

In Banner county, north of previous production, Stanolind, Kerr-McGee Oil Industries and Phillips found production in the Harrisburg area, Sec. 6-18N-55W, and Stanolind later established production at South Harrisburg, Sec. 18 of the same township. Both pools are apparently small in area, but development and exploratory drilling is continuing.

In the Deuel county area, east of the majority of Ohio's discoveries, C. D. Edmonson and others have gas production in the Big Springs area, Sec. 19-13N-42W, with some completions estimated as high as fifteen million cubic feet of gas daily. Production is distributed by the Kansas-Nebraska Gas Co. through the central part of the state. There has been no production found in exploratory wells east of this area in the basin.

The majority of exploratory and development drilling in the Colorado portion of the basin has been in the central Logan county area. British American and Shell have been the most active operators through this area. However, Trigood Oil Co. of Casper found the second pool in the county with completions of a discovery at Merino, Sec. 19-6N-54W, in July, 1950. The well was located on a block farmed out from Ohio on which the latter did seismic work. A total of 15 oil wells has been completed in this field.

British American established production in the Yenter and Walker pools in late 1950 and Shell found oil in the Mount Hope pool in November 1950, starting a drilling program near the town of Sterling. Production at Walker and Yenter pools is from the Third Dakota, or J sand, while that at Mount Hope is from the First Dakota, or D sand. The Second Dakota, G sand, of Nebraska is not present in this area. Each of these three pools were drilling following seismic work in the area by these operators. More than 60 producing wells have been completed in these three fields, which are the largest producing fields in the Colorado portion.

During 1951 the discoveries continued for the Colorado portion of the basin, with 128 wildcats drilled and 14 discoveries. Shell Springdale, Ginther - Warren - Ginther's Noonen Ranch, Plains Exploration's West Sterling, The Texas Company's Padroni, British American's Arford and Graylin, H. C. Arnold's Hoover Pool, Recco Oil Company's Messex and Orrin Tucker's Little Beaver were all 1951 discoveries. With the exception of Graylin and West Sterling, there has been little development drilling in any of these pools.

The year 1952 has started off well for the basin. British American has a new discovery in the Schwake area, NE SW NE 6-11N-52W, northeast of the Armstrong pool, Logan county, Colo., and the well flowed oil at the rate of 20 barrels per hour on test of the J sand at approximately 5,300 feet. Shell found a new pay producer at Southwest Potter, eastern Kimball County, Neb., with the well making oil from the J sand. Ohio has a new discovery in the Olson area, 5-14N-48W, Cheyenne county, Nebr. Sinclair is presently completing its Parke wildcat in central Logan county, Colo., after the well made oil on drill stem test of the D sand.

Geophysical operations during the past two years have kept pace with the wildcat drilling. A number of operators, including Champlin Refining Co., Ohio, Magnolia, Stanolind, Lion, Superior, Continental, Sinclair, Shell, Niloco, Murphy Corp. and others have crews in the area. A total of 36 crews were working in the area a large part of the year, with the area the most active in the Rocky Mountains during the fore-part of the year. Credit for the majority of the current discoveries in this basin is given seismic work, with the result that this is expected to increase during the coming year. There has been insufficient control, by reason of lack of drilling through most of the basin, to allow for subsurface geological work. However, it is expected that with additional drilling, subsurface work will account for more discoveries.

During 1951, pools in the Denver-Julesburg basin produced 3,374,561 barrels of oil. Of this, 1,449,238 barrels was from western Nebraska fields and 1,363,383 barrels from Colorado, with 561,940 barrels from the Borie and Horse Creek fields in Wyoming. New production (in the currently active eastern portion of the basin, and developed since discovery at Gurley) accounted for more than 2,500,000 barrels of the 1951 production. The majority of the wells had curtailed production rates throughout the year due to lack of pipe line facilities. At the present time oil from some of the new pools is being trucked from fields in both Colorado and Nebraska to Northport, Neb., some 35 miles north of the town of Sidney, where it is transported via Service Pipe Line (Standard of Indiana) to mid-western markets. Lack of space in the line, currently delivering 60,000 barrels of Rocky Mountain oil daily eastward, limits the take from the Denver-Julesburg basin to around 5,000 barrels daily. Some oil is delivered to refineries at Cheyenne and Denver, but these refineries have contractual obligations for other Rocky Mountain crude and cannot take all surplus from the new fields. However, with completion of the 90,000 barrel daily Platte Pipe Line from central Wyoming to Wood River, an ample market will be offered producers of the Denver-Julesburg area. Operators of the Platte, Ohio, Sinclair, Pure, British American and Continental are heavy lease holders through the Denver-Julesburg basin, and these companies are carrying on active exploratory programs to augment their present crude production in the area.

The future of drilling through the basin seems assured. Since the discovery of oil at Gurley in May, 1949, there have been 38 new pools discovered, covering an area trending more than 100 miles northeast and southwest and approximately 90 miles east-west. The increased tempo of discoveries through this area will undoubtedly lead to many more wildcat discoveries. Also, exploratory drilling will extend in every direction from the presently producing area. In Washington County, Colo., for example, where pools offset to the north and west, there is no production. However, only 18 wells have tested the Dakota series sands in the county, covering 2,320 square miles. One well to each 140 square miles is the drilling density in this county, as compared to much greater density in other oil areas.

Areas along the Chadron arch of central Nebraska and the Las Animas arch of east-central Colorado are presently being worked with geological and seismic methods, prior to exploratory drilling. In the past two years there have been very few wells drilled to Pennsylvania along these arches, although shows of oil have been found in a number of the earlier tests drilled to that formation. Ben F. Brack Oil Co. found oil in that formation during the past year at a wildcat in Cheyenne County, Kans. causing renewed interest in production possibilities of older beds. There are no other producers in deeper formations in this basin.

There have been two deep tests in fields where Cretaceous oil was found in southwestern Nebraska, and both were drilled by Ohio. At the present time no tests have been drilled in the Logan-Morgan-Weld County, Colo., producing fields below Cretaceous. During the coming year a number of wells are proposed to Pennsylvanian and deeper formations, and outcome of these wells will be of considerable importance for future drilling.

With the large number of operators, both major and independent, presently having lease holdings, the present high discovery rate on seismic prospects, low drilling costs and a promised market, the future looks good for oil activity in this basin.

Venezuela Wildcatting Active

Wildcat drilling is active in Venezuela and a number of important new tests are planned. Proposed locations include Catalan-1, to be drilled by Texas for Creole's account in southern Buchivacoa district, state of Falcon. Atlantic will resume exploration in the Guama area, north of the Tucupido-Taman field, with Guama-2, now rigging up. Guama-1 was suspended in 1950 after a series of hardships including fire and flood. Sinclair has scheduled a "Roblete" wildcat to be drilled northwest from the town of Chaparro, and one called "Rositas" in the area west of Atlantic's Ruiz field, where dry hole Dakoa-1 was drilled last year.

Creole is preparing location for a second Alturitas test at a site four miles from the first hole. Alturitas-1, at final depth of 17,039 feet, the deepest hole ever drilled outside the U. S., was nearly two years in drilling and testing. Normal problems were increased many times by the inaccessibility of the location, in the wild-Indian country of the Rio Negro in the southwestern Lake Maracaibo area. Because of mechanical difficulties (principally a collapsed liner), testing was inconclusive, but the hole was reportedly capable of production from several Eocene and Cretaceous intervals.

On the other side of the country, Texas was rigging up on Rincon-5, a wildcat, and the first well to be drilled in their Rincon Largo field for several years. Pantepec meanwhile was preparing to deepen Roble RPN-19 and 27 to the Merecure. A new firm, Servicios Tecnicos Orientales, CA (STOCA), will do this work and manage all Roble and Mulata field operations for Pantepec. Head of this firm is John Bailey, Creole's superintendent at San Joaquin until recently. Having abandoned CQ-1 in December, Shell spudded in Boqueron BQ-1, in the same general untested area near the Andean town of Valera, in late January. This latter location has a ground elevation of 3,489 feet (as compared with an average of sea-level for the wells of the Lake Maracaibo area and of 900-1,000 feet for the important Eastern Venezuela oilfields), which is thought to be a record for Venezuela. Farther north, in the Pueblo Viejo field, Shell's deep test LS-1387 was coring near 10,000 feet in early February, having spudded in March, 1951. VL-5, test of a large block of acreage several miles offshore in Lake Maracaibo, was coring below 7,000 feet. Ballenato BA-2, suspended in 1946 at 7,020 feet at a site about 16 miles east of Lagunillas, was coring below 7,300 feet in the course of deepening to the Cretaceous.

Shell's Canadones DMC-2, northeast of Mara field, was abandoned at 10,346 feet in mid-January after a long and apparently hopeless fishing job. Sibucara-7, near the Maracaibo airport, had reached a depth of 13,903 feet, but was sidetracking at near 10,000, and Sibucara-8, at 13,565 feet, was said to be testing over 2,000 b/d in early February. Shell spudded another Cretaceous test, C-151, south of their Concepcion field. The fish on which WT-11, Shell hole in the west Tarra field near the Colombian border, had been milling for several weeks was finally got out of the way and the hole was approaching 8,600 feet.

Richmond's Perico-1, on the Colombian side of the Goajira Peninsula, was drilling at almost 10,000 feet as February began. Creole's Cumarebo CU-136, new-pool test in the high-gravity Cumarebo field of coastal Falcon, was sidetracking below 5,000 feet.

In Central Venezuela (Guarico), Venezuelan Atlantic suspended Retumbo-1 at 5,507 feet in early January, abandoned Monal-4 at 3,805 feet, and was drilling at 3,300 feet on Tamanaco-1 in western Guarico. This last is in the Mellado lots, where Creole drilled several dry holes before transferring the acreage to Atlantic. Sinclair abandoned Piedra Azul-1, north of Atlantic's Tucupido field, at 10,007 feet after a lengthy testing program. Alacran-1, a Sinclair new field test south of the village of Chaparro, continued rigging up. Texas-Mercedes abandoned the western Guarico wildcats Punzon-4 and Palacio-77 at 4,725 and 3,635 feet respectively. Their Dakoa 8-3, second well in the new area west of Tucupido field, was abandoned at 3,800 feet as February began.

In Eastern Venezuela, Tonoro-2, operated by Creole and jointly owned by it with Phillips and Atlantic, reached 11,030 feet as February began, and early reports were pessimistic. Creole's deeper-pool test in Quiriquire, Q-533, was testing at final depth of 8,067 in sidetracked hole, and Pedernales PCA-22 was drilling near 7,000 feet. Phillips began an exploratory Ana-1 in the Greater Anaco area. Texas's Mata-5, northeast of the Greater Oficina area, was still making hole at 11,898 feet as a deeper-pool test, while Mata-3, new pool wildcat, was drilling near 6,000 feet. Socony's Greater Anaco Cantaura-1 had reached bottom at 11,964 and was beginning to test. In late January Mene Grande abandoned East Chipo-1, but completed Tapuco-1 (southwest from the Soto wells) as a very satisfactory dual-zone producer, both below 10,000 feet. Northern wildcats still drilling included Barba-1, 6,200 feet; QXG-3, 7,500 feet; and Divi-1, 9,000 feet. Mene Grande spudded two new wildcats, Rita-1 in the north Mipa area, drilling at 5,900 in early February, and north Chimire SXM-101, making hole at 4,000 feet.

Wood Heads Houston Nomads

Herschel J. Wood was unanimously elected president of the Houston chapter of Nomads at the January meeting. Other new officers are Robert K. Franklin, vice president; E. F. Baldwin, secretary; Madden T. Works, assistant secretary; C. L. Clausel, treasurer; W. L. Childs, Jr., assistant treasurer; Fred Christanelli, sergeant at arms; Ed Louden, assistant sergeant at arms; E. L. Lorehn and Noble Endicott, regents; and Harry E. Estes, executive secretary. The new officers were installed at the club's annual dinner dance held Jan. 26 at the Shamrock Hotel.

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By Joseph Huttlinger

WASHINGTON

THE PETROLEUM Administration for Defense has conducted further studies of future oil requirements in the United States and elsewhere outside the Iron Curtain countries. As a result it has developed a program covering the period July 1, 1952 through December 31, 1953.

The new international oil program calls for the drilling of 90,128 new oil wells at home and abroad during the 18-month period; expanding refining capacity at the rate of 859,000 barrels daily each year; laying 23,500 miles of new crude oil and products pipe lines; and adding storage capacity totaling 188 million barrels. The program bears an estimated price tag of $10,500 million and will require 12 million tons of steel.

Bruce K. Brown, deputy petroleum administrator, says the program is a minimum to meet wartime military and rationed civilian requirements. Allied military demands have been estimated publicly at about four million barrels daily in the event of war.

The United States targets envisioned by PAD include these:

1—The drilling of 80,000 new oil wells, at a cost of $6,600 million, 25,000 of them in the last six months of this year, and 55,000 next year. The current drilling rate is 44,000 new oil wells a year.

2—An increase in crude oil producing capacity of 642,000 b/d to a total of 7,600,000 b/d. This would be about one million barrels daily above estimated demand for U. S. crude oil by the end of the 18-month period.

3—The construction of 19,700 miles of oil pipe lines and 153 million barrels of tank storage at a cost of $747 million; about 7,700 miles of line would be laid in the last six months of this year and 12,000 next year.

4—The addition of 712,000 b/d of new refining capacity at a cost of $1,290 million. The present refinery expansion has been at a rate of 320,000 b/d per year, or 480,000 b/d in 18 months.

5—Natural gasoline plant construction of $195 million and marketing facility expansion, $24 million.

The foreign targets of expansion in the western world include these:

1—The drilling of 10,128 new oil wells at a cost of $775 million, of which 3,376 would be in the last six months of this year, and 6,752 the following year. A total of 3,600 wells was drilled in the areas in 1951, and the 1952 estimate is 5,400.

2—This would add 867,000 b/d to a crude oil production capacity of something close to five million barrels daily at the present time.

3—The construction of 3,800 miles of oil pipe lines and 35 million barrels of tankage at a cost of more than $80 million, of which 1,000 miles would be product lines.

4—An expansion of refining capacity 576,000 b/d at a cost of $845 million.

A breakdown of the dollar cost shows the following between the U. S., Canadian, and other foreign areas:

Country	Six Months 1952	1953
	(Millions)	
United States	$2,813	$6,023
Canada	88	212
Other Foreign	509	880
	$3,410	$7,115

The steel requirement breaks down as follows:

Country	Six Months 1952	1953
	(Tons)	
United States	3,435,240	6,798,635
Canada	197,464	300,928
Other Foreign	423,932	809,666
	4,056,636	7,909,229

By drilling 80,000 wells in the United States, 4,020 wells in Canada, and 6,108 wells elsewhere in the western world during the 18-month period, PAD figures that crude output will be increased 542,000 b/d in the last half of 1952 and an additional 967,000 b/d in 1953. A reserve producing capacity of 1,019,000 b/d would be built in the United States, and western world demand of 11,911,000 b/d in 1952 and 12,588,000 in 1953 would be met. U. S. production in 1953 is estimated at 6,581,000 b/d and western world foreign at 6,007,000 b/d.

Fair prices for crude and products are a must if the industry is to finance the expansion. The price of steel is headed upwards, but even if it were not, crude oil producers claim to face a price squeeze and plan a trip for relief to the Office of Price Stabilization. Products naturally would follow crude oil upwards. Refinery workers' wages are also going higher. This will accentuate situations such as those now existing in the east coast fuel oil market.

The OPS allowed tanker rates to go so high that oil companies could not afford to bring fuel oil to the east coast. Oil companies, the PAD and others warned of trouble ahead, and OPS agreed to a subsidy, then changed its mind on that. Maybe there won't be a shortage, and maybe the companies will bring in the fuel oil at a loss, the OPS said privately.

This, of course, is exactly what the patriotic oil industry agreed to do. Fourteen oil companies agreed to take a loss of up to $7 million to prevent any shortages, but fuel oil was not the only example of disastrous price ceilings. Bunker oil and Navy Special fuel oil ceilings were set so the industry could not afford to make these products, and month after month, as shortages continue, the OPS still remains adamant.

Venezuela's Oil Economy

(Continued from page 74)

has definitely linked the growth of the Venezuelan petroleum industry with the supplemental oil needs of North America, and in the light of prospective requirements in the Western Hemisphere during the next five years, it is imperative that immediate action be taken to expand the margin of crude oil availability in Venezuela. A forward step in this direction can be made now by the granting of new concessions.

The situation that confronts the petroleum industry today, with respect to expanding the productive capacity of crude oil, is not confined to Venezuela alone. New sources of oil supply must be found and developed throughout the Western Hemisphere, if future requirements for petroleum and its products are to be met within the safe physical limits prescribed by sound conservation practices.

Errata

Two corrections should be noted in connection with Mr. Struth's first article which appeared in the February number. In the tabulation on Page 35 the increase in United States oil demand in 1951 should have been 8.7 percent instead of 9.4 percent. A minus sign should have appeared before the figure 369,000 at the foot of the same column to indicate that the United States had a shortage of 369,000 b/d of oil in 1951 from domestic sources.—Editor.

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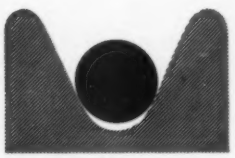
With sheaves, oil the bearings at frequent intervals and check that they rotate freely. A seized up sheave can ruin a rope very quickly. Watch alignment too; see that sheaves, drums and pulleys are set exactly in line with the rope that is working over them.



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British Oil News

By E. Lawson Lomax

European Refinery Progress

Built at a cost of over 8,000,000 pounds ($22,400,000), new extensions to the Shell Berre refinery near Marseilles were officially opened on January 17, making the Berre refinery one of the largest in France. The crude throughput is now approximately 3,000,000 tons per year against 1,140,000 tons in 1950.

Along with this refinery and other installations at Petit Couronne, near Rouen, and Pauillac, Bordeaux, Shell now has a refining capacity in France of over 5,000,000 tons per year.

The feed stock for these refineries is derived about 70 percent from Kuwait, with smaller quantities from Iraq and Venezuela, together with minor percentages from France and Algeria.

The new extensions at Berre consists mainly of an 8,000 ton per day crude distillation unit and a 1,200 ton thermal reforming unit. Future extensions envisage the addition of a cat cracker unit to be completed by the end of 1953.

The Antwerp refinery of Anglo-Iranian and Petrofina is now producing at a rate of about 2,000,000 tons per year.

Porto Marghera refinery at Venice, in which Azienda Generale Italiana Petrolia is associated with Anglo-Iranian, has stepped up production from about 700,000 tons in 1951 to 1,250,000 tons.

The Dunkirk refinery of Societe Generale des Huiles de Petrole, B.P., is producing at a rate of 2,000,000 tons annually as compared with last year's production of 640,000 tons.

Anglo-Iranian's Eurotank and Schindler refineries in Germany have now a combined production of 820,000 tons per year.

New Buyer at Weir's

R. H. Cruickshank has been appointed buyer for G. & J. Weir, Ltd., Cathcart, Glasgow, succeeding Crawford T. Robertson, who retired at the end of 1951. Mr. Cruickshank has been with Weir's since 1923, with the exception of six years when he represented a steel company in Scotland. He returned to Weir's as deputy to Mr. Robertson in the early part of 1951.

Personalities

The services of many of the personnel who were actively engaged in operations connected with the oil dispute in Persia were recognized in the New Year's Honors list, among them being five members of the Anglo-Iranian Oil Co.'s staff in Persia, together with J. P. Berkin of the Shell Petroleum Co. who was made C.B.E.

Mr. Berkin's long career with Shell has included service in Sarawak and four wartime years as an executive vice president in New York. He was chairman of the emergency committee set up to meet the big supply gap caused by the Persian stoppage whereby the international companies have provided from other sources the equivalent of 32 million tons of oil products and prevented breakdown of supplies.

A. E. C. Drake, also made C.B.E., joined Anglo-Iranian as accountant in 1934. He was transferred to Iran in 1938, and after holding a number of posts in the accounts department, was appointed in 1944 as commercial superintendent in the General Refineries Organization. In 1950 he was appointed general manager in Persia and Iraq, which position he held until all company employees were withdrawn from Persia.

C. E. Evans and J. W. Jackson were designated O.B.E.'s Mr. Evans joined Anglo-Iranian in 1939 after many years service with the London and Thameshaven Oil Wharves Ltd. where he had been refinery manager. He went to Abadan in 1940, becoming assistant chief chemist in 1943 and personnel manager in 1945.

In 1949 he was appointed works manager of the refinery, and held that post until the withdrawal of the British staff from Abadan. He has now been appointed manager of the British Petroleum chemical plant at Grangemouth, jointly owned by A.I.O.C. and the Distillers Company, and manager of Forth Chemical Ltd., a joint subsidiary of British Petroleum Chemicals and Monsanto Chemicals, Ltd.

Mr. Jackson joined Anglo-Iranian in 1930 and was posted to the Iranian oilfields as an engineer. For several years he worked on "outside tests" in search of new oil deposits, and in 1936 went to the Gach Saran field. In 1944 he was appointed fields superintendent at Naft Kaneh and Naft-i-Shah, and in 1947 was transferred to Lali and then to Agha Jari. He was appointed fields manager of the southern oilfields in March 1950, and is now located in the company's London office.

R. K. Blackwood and Mrs. Dorothy Ridge were made M.B.E.'s. Mr. Blackwood was superintendent of Anglo-Iranian's pipe line construction group in Persia. He joined the company in 1938 and was employed on various pipe line projects, including the laying of the 22-inch line from Agha Jari to Bandar Mashur. He is now located in Kuwait.

Mrs. Ridge was appointed matron of Anglo-Iranian's hospital at Abadan in January 1951, and remained in this post until the evacuation of the company's staff in October last.

Aden and Australia

An Anglo-Iranian Oil Co. survey party, headed by S. E. Evans of the company's geological staff, left for Aden on February 2, where they will join another four-man party led by J. McV. Luard and including personnel, engineering and administrative representatives of the company. The object of these visits is to investigate the possibility of constructing at Aden a new A.I.O.C. refinery with a probable annual capacity of 5,000,000 tons.

Meanwhile, A. E. C. Drake, formerly general manager at Abadan, has left on a vist to Australia in connection with the plan for a new A.I.O.C. refinery near Freemantle. As Senator W. H. Spooner, Australian National Development Minister, recently announced, the Commonwealth government and the West Australian government have reached broad agreement with the A.I.O.C. on this project. The proposed refinery would process 3,000,000 tons of Middle East crude annually, and would be by far the largest in Australia.

Vacuum Oil Company Enters Motor Spirit Market

On the first day of the year, a small ceremony was held at Mill Garage, Woodford, Essex, to inaugurate the Vacuum Oil Co.'s entry into the motor spirit market. While the company cannot yet market its branded spirit "Mobilgas," and at present along with other suppliers can only market "pool spirit," yet this is the start of its campaign for a share in the market when branded spirit can be sold and when its new refinery now being erected at Coryton is in production.

The company already has a large trade for the supply of its well known lubricating oils under the trademarks of the "Flying Horse" and "Gargoyle," and is now making an effort to become a full supplier to the motor industry.

The first filling from the "Mobilgas" pump was made into the tank of the car of Mr. John Cobb, the distinguished British motorist, but the spirit was "pool."

New Lubricating Oil Storage System

A unique oil storage tank has been built for the Vacuum Oil Co. by William Neill and Sons (St. Helens) Ltd., the first one of its kind to be built in Britain and the second one in the world.

It is a completely welded structure, with 99 rectangular compartments of varying sizes for the storage of blended oils prior to packaging, and is situated directly over the packaging department at the company's Birkenhead works.

This allows rapid filling and despatch of all types and sizes of containers, and assures customers of being supplied with their various requirements of lubricants to correct specifications.

J. P. Berkin | A. E. C. Drake | C. E. Evans | J. W. Jackson | R. K. Blackwood | Mrs. D. Ridge

THE MAN IN THE IRON MASK

THIS man is a welder working on a new pipe-line at one of Anglo-Iranian's three oil refineries in the United Kingdom. Anglo-Iranian's refinery expansion continues on a world-wide scale. In addition to the nine refineries in Europe and Australia already operated by Anglo-Iranian and its associated companies, a new refinery in Belgium has just gone on stream and another new refinery is under construction in the United Kingdom.

THE BP SHIELD IS THE SYMBOL OF BP THE WORLD-WIDE ORGANISATION OF

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New Treating Tower for Propane De-Asphalting at Llandarcy

Owing to the fact that the new treating tower for propane de-asphalting at A.I.O.C.'s Llandarcy refinery has to work at a pressure of between 500-600 lbs. per square inch and a temperature of over 200° F, it was considered that erection on site was not a practical proposition, since the 2½-inch thick plates had to be fusion welded, stress relieved and then X-rayed to make sure that the welds were faultless. Therefore it was decided that full fabrication should take place at the works of the manufacturers, Babcock and Wilcox Ltd. of Renfrew.

The approximate overall length of the tower is 69 feet, 9 inches, its approximate diameter 12 feet, and the weight stripped down for transportation 126-132 tons. These sizes and weights ruled out long distance transport by road or rail, and so it was decided to make the major portion of the journey by sea. It was therefore sent the ten miles from Renfrew to Glasgow by road, and there loaded into a tank landing craft specially prepared to carry it under its own power from Glasgow to Swansea, where it was again loaded onto land transport for its final journey to the site.

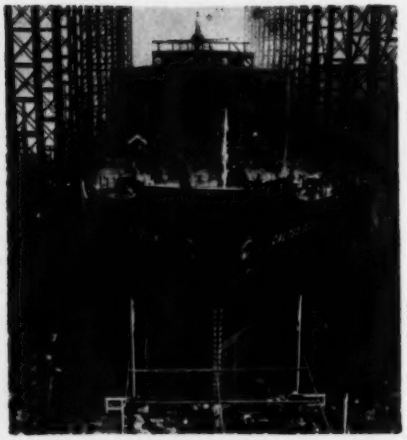

Photo taken at the January 10th launching of the "Caltex Delhi" at the Sunderland yard of Wm. Doxford & Sons, Ltd.

The company has placed orders for six 32,000 dwt tankers, the keels of three having been laid down, the first launching being due for the end of the year. In 1951, eleven tankers were launched for this company of a total deadweight tonnage of 192,800.

On January 29, the 32,000 dwt tanker "World Concord," built to the order of the North American Shipping and Trading Co., (London) Ltd. (Stavros S. Niarchos), was launched at the Barrow-in-Furness shipyard of Vickers-Armstrong Ltd. by the Countess Mountbatten of Burma.

A feature of this launching is the fact that "World Concord" carried a works job number of 1,000, a matter of congratulation to the present owners. The present site of the yard was first used for shipbuilding by the Iron Shipbuilding Co. in 1871. By the time of the launching of the "Duke of Devonshire," the first ship built in the yard, the name had been changed to Barrow Shipbuilding Co. In 1888 the works were taken over by the Naval Construction and Armament Co. This name continued until 1897, when it became Vickers Sons and Co., and shortly after, Vickers Sons and Maxim Ltd. In 1911 the name was again changed to Vickers, Ltd., and in 1928 to its present name, Vickers-Armstrong Ltd.

Britain Building Supertankers

During January 1952 a number of important launchings of tankers have taken place at British Shipyards—important not so much as to the launchings themselves, but as stressing the dependence of the oil industry upon this method of transportation of its products and the dependence of future increased production on the availability of tankers for the movement of crude oil to refining centers.

On January 10, the "Caltex Delhi" was launched at the yard of Wm. Doxford & Sons Ltd., Sunderland, the launching being sponsored by Mrs. Arne Moltzau, wife of the manager of Caltex Oil A.B. (Sweden).

The vessel was built to the order of Overseas Tankship (U.K.) Ltd., which was incorporated in August 1950 as an associate of the Caltex group who through their associate, Regent Oil Co. Ltd., are distributors of Regent and Caltex petroleum products in the U.K. Overseas Tankship (U.K.) Ltd. was established to own and operate British flag tankships, primarily for the purpose of reducing dollar committments in sterling countries by enabling these tankships to replace dollar operated vessels in the sterling area.

By the end of 1951, the company owned or managed 22 vessels of the T2 type or equivalent, while it had placed contracts, or reserved berths pending completion of contracts, for eleven new tankships to be built in British yards.

From this program of new building, "Caltex Delhi," a motor vessel of 12,000 dwt powered by 5,510 bhp Doxford diesel engines, and with a speed of 13.75 knots, is the third vessel launched, the fourth being due for launching in March of this year. In addition to these four vessels, contracts have been made for a further seven vessels, four to be built by R & W Hawthorne Leslie and Co. Ltd. at Hebburn, two by Furness Shipbuilding Co., Ltd., Haverton Hill-on-Tees, and one by Scotts Shipbuilding and Engineering Co. Ltd., Greenock.

These seven tankers will vary in size from 17,100 dwt to about 18,000 dwt, and will all have geared turbine propulsion, giving a service speed of about 15 knots.

On January 15, the "British Skill" was launched at the Belfast yard of Harland and Wolff by Lady Slim, wife of Field Marshall Sir William Slim, chief of the Imperial General Staff. This is the last vessel to be launched of the six 28,000 dwt tankers built in British yards for the British Tanker Co. Ltd., the Anglo-Iranian Oil Company's shipping organization.

Two of these vessels, the "British Adventure" and "British Bulldog," are now in commission. "British Talent" underwent her sea trials at the end of February, "British Realm" will follow in March and "British Crown" in April.

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by E. Ospina-Racines

Member of: A.I.M.E.; A.A.P.G.; A.C.S.

A detailed study of the law of supply and demand in terms of U. S. and World oil

Being an outline and analysis of how the law of supply and demand operates in the world oil industry and how the basic economic factors governing oil supply, demand, price and time lag of the United States oil industry, the geography of the world's prospective oil land together with the oil policies, which may be identified with the various governments, establishes the conditions which promote or limit the development of the world's oil resources.

CONTENTS—CHAPTERS

1. Pattern of the Oil Supply-Demand-Price Cycle.
2. Operation of U. S. and World Supply-Demand.
3. World Oil Demand and Markets.
4. Pricing Crude Oil in the World Market.
5. World's Undiscovered Commercial Oil Land.
6. Appraising Prospective Oil Land.
7. Conversion of Prospective into Commercial Oil Land.
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During the luncheon after the launching, presided over by Lt. General Sir Ronald Weeks, chairman of Vickers Ltd., it was announced by Stavros S. Niarchos, head of North American Shipping and Trading Co. (London) Ltd., that a prior order for two 32,000 dwt tankers of 15 knots had been modified to two new vessels of 44,000 dwt with a speed of 17 knots, which are the largest tankers as yet ordered in the world, and that on their completion both vessels would be under charter to the Anglo-Saxon Petroleum Co., Ltd.

The principal dimensions of these ships are approximately as follows:

Length overall	757 feet
Breadth	97 "
Depth to upper deck	52 "
Maximum Draught	36 "

The propelling machinery will be single screw geared turbines, designed to develop a maximum of about 20,000 shaft horsepower.

An indication of the performance of these new tankers can be gained from the fact that each ship will be able to transport annually a greater tonnage of petroleum than was formerly carried in five typical pre-war tankers, and that the cost of carrying this oil will be only about 60 percent of the present ruling rates. Their radius of action will be somewhat limited, as oil ports able to berth vessels of this size are not universal. Evidently they are being built for a special purpose, i.e. the transfer of crude oil from the production ports to the ports at refining centers.

Indicative of this trend is the fact that the timber oil jetties at the petroleum harbor in Queen's Dock, Swansea, the discharge and loading port of the Anglo-Iranian's refinery at Llandarcy, are being replaced by reinforced concrete jetties designed by the consulting firm of Rendel, Palmer and Tretton, and that water approach to them is being deepened by dredging to make them accessible to these large tankers. The soil thus dredged has been deposited on the landward side, providing a potential storage site.

E. J. Shearer, right, of Overseas Tankship (U.K.) Ltd., chats with J. Ramsay Gebbie, left, of Wm. Doxford & Sons, Ltd.

Name General Manager "Shell" Refining and Marketing Company

E. LeQ. Herbert became general manager of the "Shell" Refining and Marketing Co. on New Year's day, following the retirement of J. A. Oriel, for health reasons, after 30 years' service.

In this capacity, among other duties, he will exercise control over the operations of all Shell's refineries in the United Kingdom, which now have a combined capacity of 8,500,000 tons per annum. He was on refinery work in Mexico for 11 years from 1927, and returned to England to become refinery manager at Shellhaven, but soon after was moved to the head office where he was assistant general manager for some time previous to his present appointment.

Personnel Changes

Newman Hender and Co., Ltd. reports that R. W. G. Pool and G. B. Bass have been appointed directors of the company as of January 1, 1952.

Shell-Mex and B.P. announces that R. P. Williams, formerly representing bitumen interests in South Wales, has been appointed bitumen manager, western division.

European Association of Exploration Geophysicists

This association, which was formed last June during the Third World Petroleum Congress at The Hague, held its inaugural meeting on December 15 in the building of the Royal Netherlands Institute of Engineers at The Hague.

The membership, which is already 320, is mainly drawn from Europe. Headquarters will be at The Hague.

The president of the council is A. van Weelden, director of research, De Bataafsche Petroleum Maatschappij (Royal Dutch/Shell Group), and secretary-treasurer is Dr. P. Baars (Netherlands).

At the inaugural meeting six papers were read on cognate subjects by members of the association from various countries.

Book Review

Review of Petroleum Technology, Volume XI (covering 1949). Published by The Institute of Petroleum, 26 Portland Place, London, W.1. 1952. 274 pages. Price 27s. 6d. post free.

Volume eleven of this annual oil publication has made its appearance and contains a valuable and critical record of the progress made in the science and technology of petroleum during the year 1949. As in previous years, the authors have done much searching of literature to examine the material on which their review is based, and the volume contains references to nearly 3,000 technical papers and articles.

Although 1949 is the year mainly covered, there are instances where in previous years the information available has been insufficient to warrant a review covering one year only. Thus, the present volume reviews plant instrumentation for the period 1947 to 1949, crude oils for the same period, and insulating and hydraulic and bitumen for the years 1948 and 1949.

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International news and notes

Abandons Venezuela Test

Shell's Conquistador CQ-1 wildcat, near Valera in the mountains of Western Venezuela, was abandoned at 11,386 feet as December closed, after two years of drilling and four months of testing failed to find production. The rig was being dismantled to move to Boqueron BQ-1, another new-field test in the same general area about 8 miles to the southwest. Shell's deep test LS-1387 in the Pueblo Viejo field was drilling below 10,000 feet as the new year began. The same company spudded wildcat VL-5 out in Lake Maracaibo as a test of a large block of acreage due west from Bachaquero, and prepared to deepen Ballinatox BA-2, suspended in 1946 at 7,020 feet, to the Cretaceous. This location is about 16 miles east of Lagunillas. Their Canadones DMC-2, northwest from the Mara field, was undergoing a lengthy fishing job below 10,000 feet. Concepcion C-149 and C-150, wildcats northwest from the Concencion field, were drilling below 10,000 and 12,000, respectively. Richmond Exploration Company's Zulia 3G-1, midway between the Boscan and Ensenada fields, was abandoned at 10,531 feet without running casing. Their Perico-1, on the Colombian side of the Goajira Peninsula, was drilling below 7,000 feet. Mene Grande Oil Co.'s 1-MXZ-1, northeast of the Mara field, was suspended in mid-December at 6,866 feet.

In Guarico (Central Venezuela), Venezuelan Atlantic abandoned Julio-1 at 4,506 feet without running casing, 2 miles northeast from Santa Maria de Inire and moved the rig to Retumbo-1, in the same general vicinity. This was testing at 5,507 as 1951 began. Sinclair's Piedra Azul-1, 7 miles north from Tucupido field, was engaged in a lengthy testing program at final depth just below 10,000 feet. There was one new-field discovery in Guarico in this period, Texas Company's Dakoa 8-1, west of the Tucupido field, which was completed at 4,605 feet.

In Eastern Venezuela, Creole plugged and abandoned J-449 at 5,901 feet. This was a new-pool test in the north-central Jusepin field. Jointly with Phillips and Atlantic, Creole spudded Tonoro-2 one mile southeast from hole Tonoro-1, in eastern Monagas. Among the seven Mene Grande Oil Co. wildcats operating at the beginning of 1952, only Tanuco-1 in the Greater Oficina area was testing. Early reports indicated that this was an important discovery.

Among the important wildcats scheduled was Sinclair's Alacran-1, in Guarico south of the town of El Chaparro.

Commissary Sales Rise

Monthly average sales in the commissaries of the Shell companies in Venezuela rose from $450,000 in 1950 to $700,000 in 1951. The cost of operating the present establishments (including one in Caracas and another at the Punta Cardon refinery) came to $2 million in 1951. Among the hundreds of items handled by these and other company commissaries in Venezuela, there are 31 articles of prime necessity (milk, rice, sugar, etc.) which the labor law stipulates must be carried and sold at subsidy prices.

Petrochemical Plant for Brazil

The National Petroleum Council is studying proposals to install a synthetic ammonia plant in connection with the government's 45,000 barrel refinery at Cubatao. The latter is expected to begin operating in 1953. In Bahia a Brazilian firm, assisted financially and technically by Swiss industrialists, is building a 45,000-ton per year plant to process natural gas for the government at Aratu.

Discuss Peru's Oil Laws

Caracas newspapers have given considerable publicity to the recent efforts in Peru to draft a national petroleum policy in that country. Dr. Gustavo Thery Fombona and Dr. Edmundo Luongo Cabello, high officials of Venezuela's Ministry of Mines & Hydrocarbons, were invited to Lima to advise the Peruvian Government in framing a new law for submission to the Peruvian Congress.

The Peruvian Minister of Development and Public Works, Carlos Salazar Southwell, cited Venezuela's petroleum policy as an example worthy to be followed. Peru's 45,000 b/d is insignificant compared with Venezuela's production, the Minister pointed out, although at one time Peru was the foremost oil producer of Latin America. This position was lost, he said, to "sister republics which had the vision to construct their oil laws within the framework of healthy nationalism," endeavoring to attract the collaboration of private enterprise with means and skills denied to "hermetic state monopolies."

Marine Surveys Off Venezuela Coast

In exploration activities, an interesting new development is an over-water project being carried out in the Gulf of Paria by Marine Geophysical Co. for the joint account of Creole, Shell, and four other operators in Venezuela. This is an extension of a similar joint project performed several months ago. Besides this marine survey, Shell is conducting one in Tablazo Bay, north of Maracaibo, with one of its own parties converted to water work.

For the first time in several years, a seismic party is operating on the Paraguana Peninsula of Western Venezuela. Shell is working a party on the north, or seaward side of this land mass. Texas Co. currently has a party investigating the vicinity of the narrow isthmus known as the "Medanos of Coro," connecting this peninsula with the mainland.

Tanker Burns

One of Brazil's new tankers, Salte 55, working under charter to Shell-Mex, was burnt out alongside the quay after discharging gasoline at Porto Alegre on January 4. Three members of the crew lost their lives and several were injured.

Brazil-Bolivia Development Planned

The diplomatic notes exchanged between Brazil and Bolivia at the end of January supplement the 1938 treaty relating to the exploitation and utilization of Bolivian petroleum. The treaty authorized the organization of mixed Brazilian-Bolivian oil interprises. Recent notes determine the formation of these companies and the area they are to exploit. Concessions, which include the right to build pipe lines, will be for 55 years. The area to be exploited is distinct from the Chamari-Choreti structure and embraces approximately 300 square kilometers between the rivers Ichilo and Parapeti. The reports on this zone, compiled by Standard Oil of Bolivia, together with estimates of cost of development, are to be handed to the mixed Brazil-Bolivia commission, which will remain in existence for 15 years.

The oil region of Santa Cruz de la Sierra, hitherto isolated between the River Pirai and the eastern foothills of the Andes, will be connected this year to consuming centers in Brazil and to the Atlantic port of Santos. American interests are helping to build a road to Cochabamba, which is already joined by rail to La Paz and to the Pacific ports of Antofagasta, Arica and Mollendo.

Mene Grande to Increase Production

Sidney A. Swensrud, president of Gulf Oil Corp., visited Venezuela in early February for a first hand inspection of the operations of Mene Grande Oil Co., Gulf subsidiary in that country. He told reporters in Caracas that Mene Grande's goal for 1942 would be a daily average production of 330,000 barrels per day, or about 45,000 barrels more than the late 1951 average. Of this amount, 270,000 b/d is expected to come from the Eastern Venezuela fields and about 60,000 from the Lake Maracaibo area. Some 280 new wells will be drilled on a 37-rig program as compared with a 27-rig program for 1951. Pipeline capacity will be augmented proportionately. Existing gas-repressuring and natural gasoline plants will be enlarged and new ones built in accordance with Mene Grande's policy of making the fullest possible use of the natural gas produced in the fields.

Mr. Swensrud was accompanied on his swing through Venezuela by William K. Whiteford, recently head of British American and now an executive vice president of Gulf; Claude Woessner, general manager of foreign production for Gulf; and Hoyt Sherman, president of Mene Grande.

Earlier, it had been announced that Mene Grande's 1952 budget would envision the spending of about $70 million.

Sidney A. Swensrud (third from left), president of Gulf Oil Corp., chats with Venezuelan oil officials at a cocktail party offered in his honor by Mene Grande Oil Co. Left to right are: Dr. Francisco Medina Olivieri, chief of production and fiscalization of the Office of Hydrocarbons; Dr. Gustavo Thery Fombona, director of the Office of Hydrocarbons; Mr. Swensrud; and Dr. Luis Herrera F., assistant to the president of Gulf. At extreme right is Robert M. Baskin, representative of Venezuela Gulf Refining Co.

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Guatemala May Encourage Oil Search

Dr. Manuel Noriega Morales, Guatemala's Economy Minister, has gone on record in favor of opening up his country's oil reserves to development by foreign companies, according to U. S. oil men who have visited the country lately. They quoted Dr. Noriega as stating that undeveloped oil riches have no value to Guatemala or the rest of world, and that he therefore intends to revise the nation's petroleum laws in order to encourage foreign investments.

A group of American oil companies spent considerable time and money in 1940 investigating reported oil deposits in northwest Guatemala. The results of the initial surveys were offers to sign development contracts, but the policy of the government of that time, fanned by left-wing agitators, produced the passage of oil laws the potential investors considered "impossible."

Observers believe the Arbenz administration is sincere in its desire to cooperate with foreign companies, but a serious obstacle is continuing Communist and nationalist objection to such a policy. The economic crisis undergone by Guatemala during the last two years as the outcome of declining exports of coffee, bananas and essential oils is a strong factor in favor of inducing the government to reconsider its oil policy.

Employee Bonuses In Venezuela

The oil companies operating in Venezuela distributed about 100 million bolivares ($30 million) to their personnel at year's end, in accordance with a profit-sharing program which has been in effect in Venezuela for several years. Each individual's proportion amounts to 16⅔ percent of his annual pay, or two months' salary. The three major companies will account for about two-thirds of this amount, or $20 million. Creole's 15,000 workers divided about $8.5 million, Shell's like number about $7.5, and Mene Grande's 6,700 employees about $4 million.

S. A. Newman

S. A. Newman Heads Brazilian Sales

S. A. Newman has been appointed manager of direct sales for the Companhia Brazileira de Petroleo "GULF," Gulf Oil Corporation. He will be located at the company's offices in Rio de Janeiro.

Mr. Newman joined Gulf in 1930 as sales engineer. He was superintendent of industrial sales and assistant division manager when he was called to active duty by the Navy in February 1941. On the third day of the war with Japan, he was serving as superintendent of the Navy Yard at Guam and was captured by the Japanese. For three years and eight months he was interned at a Japanese prison camp near Tokyo, and served as senior U. S. officer at the camp. At the cessation of hostilities, Captain Newman aided in preparing indictments of principal war criminals on violations of Prisoner of War rules. He returned to Gulf in June, 1946.

Plan Brazilian Wildcats

The engineer in charge of oil operations in Bahia announces that this year's program will start with the drilling of a pioneer well at Bemfica, 60 miles north of Bahia, between Entre Rios and Esplanada (WORLD PETROLEUM, October 1951). Drilling will also begin in the state of S. Paulo, near the Parana border, and equipment is now being transferred from Bahia for the purpose. The president of the Petroleum Council stated recently that there are only fourteen rigs in Brazil, a totally inadequate number for the work to be carried out.

The pioneer well at Limoeiro, near Cameta, proved dry at a depth of 4,027 meters. A new location is now being prepared at Cururu, on Marajo Island, near the city of Chaves, in order to test the oil possibilities of the Amazon Estuary.

McCarthy Seeks Venezuela Crude

Glenn McCarthy, president of the McCarthy Oil and Gas Corp., visited Caracas during December. He told reporters the object of his visit was to negotiate with the Venezuelan government for the purchase of 35,000 b/d of royalty oil. (The Venezuelan nation has a one-sixth royalty on all oil produced within its borders, which may be taken either in cash or in kind. At current rates of production, this amounts to nearly 300,000 barrels per day.)

Venezuela-Peru Cooperation

At Peru's invitation, Venezuela sent two experts of the Ministry of Mines and Hydrocarbons to the neighbor country to assist in the drafting of a new petroleum law. Venezuelan-Peruvian collaboration is now being carried a step further, with Peru sending a group of engineers north to study the Venezuelan oilfields at first-hand.

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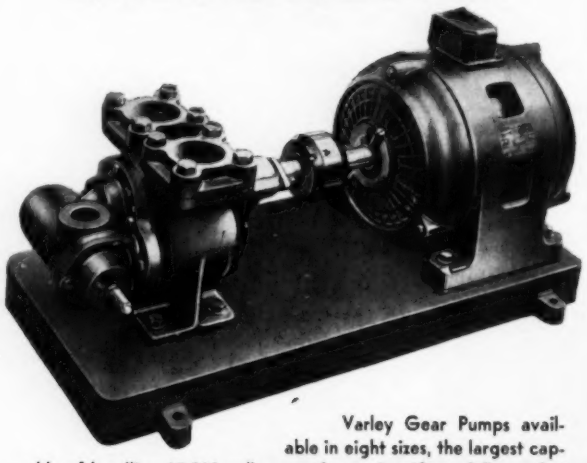

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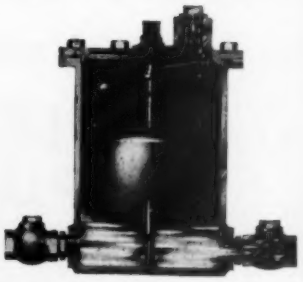

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To Double Ule Line Capacity

Creole Petroleum Corp. will begin about the middle of 1952 to lay a 150-mile, 26-inch pipe line to parallel its existing line connecting the Bolivar Coastal Fields with Creole's 60,000 b/d refinery on the Paraguana peninsula. With the old line, which has been operating since December 1948 without major interruptions and at a relatively low unit cost, the combination will be capable of moving 481,000 barrels per day. What is not needed in refinery operations will be loaded on sea-going tankers at a deepwater terminal which Creole operates at the refinery site.

The new line, which will be completed in 1953, will cost $20 million. Storage capacity will be raised to 450,000 barrels at the Ule starting-point and to 600,000 barrels at the Amuay terminal. Tank valves and gauging will be operated by remote control.

Enlarges Canadian Plant

Trailmobile production facilities in Canada have been trebled by the construction in Scarborough, Ontario, Canada, of a new manufacturing plant for Trailmobile Canada, Ltd. The new plant will serve the five Trailmobile factory branches in Canada, as well as Trailmobile distributors throughout the Dominion.

New Venezuelan Royalty Agreement

The Venezuelan Government and the oil companies have adopted a new formula for calculating the commercial value of the one-sixth royalty paid the nation, which for the past several years has been taken in money rather than in kind. (At present production rates, this amounts to the monetary value of 300,000 barrels per day.) Under the new formula, the theoretical values of crudes of 12.5 to 25° API have gone down, those of crudes between 25 to 35° API have gone up, while crudes of gravities higher than 35° remain as before. The net result is that the theoretical commercial value of Venezuelan crude has decreased by 13.332c per barrel on the average, and the national royalty has consequently been lowered by an average of 2.22c per barrel.

The scale adopted in 1943 and effective until late 1948 was based on the general principle that crudes of similar characteristics had the same value in Venezuelan ports as on the Gulf coast, the distance by water from these points to the East Coast of the United States being more or less equal. From the per-barrel value thus established, the cost of transportation from field to ocean terminal was deducted in order to arrive at the value of the oil at the wellhead, where the oil is fiscalized for royalty purposes. This method worked out satisfactorily for both the producers and the government until late in 1946. For the next two or three years, market fluctuations caused such price disparities between Venezuelan and "reference" crudes that the companies petitioned for relief.

The government agreed to suspend the formula then in use as of the first of October, 1949. Outside experts were called in to study the matter, proposals and counter-proposals were made, and in November, 1950, the Government presented a new formula which has now been adopted. Some idea of how the new theoretical values compare with those calculated under the old formula is shown in the following table:

	THEORETICAL VALUE		DIFFERENCE	
Gravity	Old Formula	New Formula	More	Less
15°	$2.25834	$1.83834		$0.42
20°	2.35834	2.09834		0.24
25°	2.45834	2.48834	$0.03	
30°	2.55834	2.58834	0.03	
35°	2.69074	2.70574	0.015	

Exploration in Mexico

Forty-four exploration crews, composed of geologists and other technicians, are participating in Petroleos Mexicanos' intensified drive to discover new oil fields. Proven zones being investigated include the sedimentary basin of the Bajo Bravo, the Tampico-Tuxpam-Poza Rica basin, the salt basin of the Isthmus of Tehuantepec and the State of Tabasco.

Wildcat areas where studies will be made for the first time comprise northern Chihuahua and Coahuila states, the area between Ciudad Juarez and Ciudad Victoria, the Veracruz basin, the State of Chiapas, the Yucatan peninsula, including Campeche and Quintana Roo, and the continental platform of the Gulf of Mexico.

To Increase Exports

Mexico will be able to export a total of about 28 million barrels of petroleum this year, in the opinion of Senator Antonio J. Bermudez, director of Petroleos Mexicanos. Domestic consumption will be approximately 55 million barrels. Sr. Bermudez expects the two billion cubic feet of natural gas produced by the Reynosa, Tamaulipas and Poza Rica fields in 1952 will be "largely marketed" in the United States. Other exports will probably include an unspecified part of the 40,000 tons of sulfur it is estimated Mexico will produce this year.

Brazilian Prices Raised

Owing to increased packing costs, the prices for gasoline and kerosine in Brazil were raised at the end of the year. The prices are now U. S. $5.92 and U. S. $5.04, respectively, per 10-gallon box at Belem, and have been raised proportionally at other supply bases.

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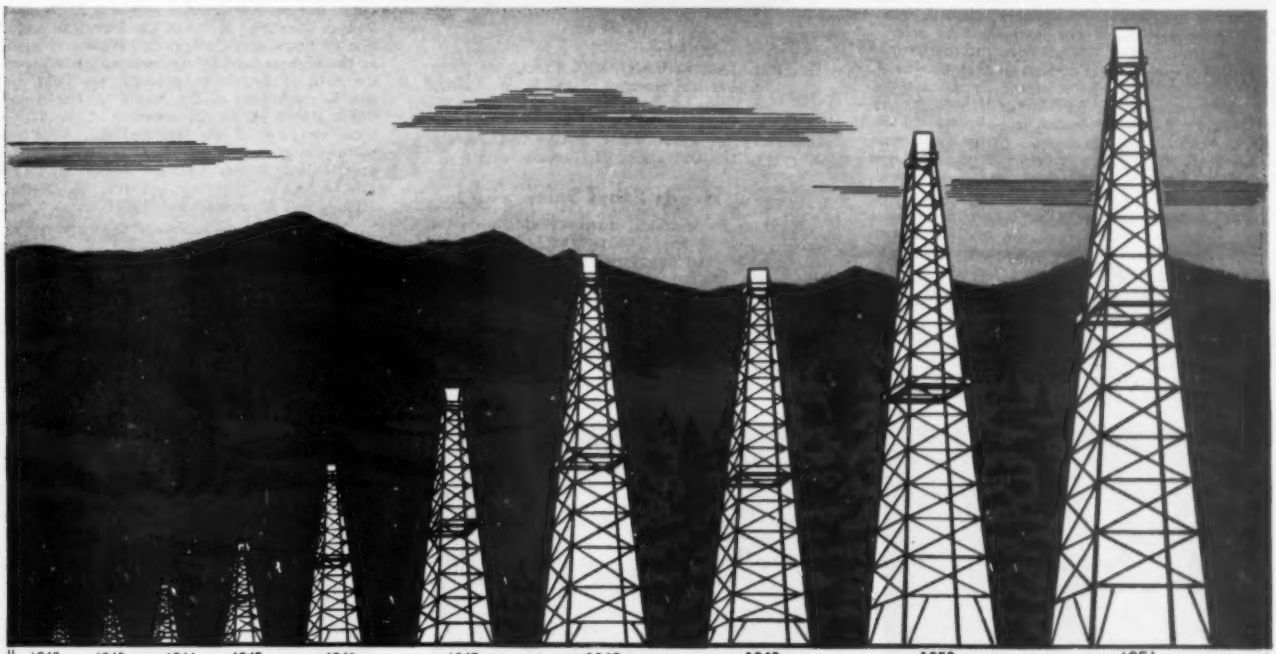

1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
43 M.B.	44½ M.B.	45½ M.B.	50 M.B.	60 M.B.	67½ M.B.	83½ M.B.	81 M.B.	95½ M.B.	108 M.B.

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Oil company staff changes

GEORGE W. CLARKE, director of exploration of Stanolind Oil and Gas Co., has been made manager of the central division in Oklahoma City, replacing J. H. Forrester who was recently appointed manager of research for Standard Oil Co. (Ind.). F. J. Schempf, manager of the Texas-Louisiana gulf coast division at Houston, succeeded Mr. Clarke in Tulsa as director of exploration. The new division manager at Houston is F. R. Yost, now manager of the producing department and a director. Frank Lindeman, Jr., general superintendent of the producing department, moved up to manager of the producing department, and was succeeded by Whitney M. Elias, chief engineer of the producing department. Lewis W. Finch became chief engineer.

DALE R. SNOW has resigned as a vice president of Sunray Oil Corp. He will remain director and will have an office with Sunray to serve in a consulting capacity.

After graduation from the University of Chicago in 1916, Mr. Snow worked briefly for the old Roxana Petroleum Corp., served in the U. S. Army during World War I, and in the geological department of the old Marland Oil Co. in 1919. He joined the Waite Phillips organization in 1920 as chief geologist, and when that company merged with the former Barnsdall Oil Co. in 1925, he became chief geologist and manager of exploration for Barnsdall. When Barnsdall merged with Sunray in the summer of 1950, he was elected a director and a vice president of the enlarged corporation.

ROBERT E. FRIEDMAN has been appointed assistant to executive vice president P. S. Magruder of the General Petroleum Corp. Mr. Friedman came to General Petroleum in 1950 after a year as assistant to the president of the Trunkline Gas Supply Co. Previous to that he was in the Oil and Gas Division of the Department of the Interior. During World War II he served in the United States Navy and was assigned to the Army-Navy Petroleum Board. Later he became director of the supply and transportation division of the PAW.

J. V. C. MALCOLMSON has been appointed assistant general manager of the marine department of The Texas Co. He succeeds E. O. Perkins who has been made general manager of the supply and distribution department. Mr. Malcolmson joined Texaco in 1942 in the construction and repair division of the marine department and became manager of that division in 1948. Mr. Perkins has been with Texaco in various jobs since 1920. He entered the marine department as assistant general manager in 1948.

J. V. C. Malcolmson

Heads Baroid Export Sales

L. W. Jones has been appointed export manager at Baroid Sales Division, National Lead Co., Houston. A native of Houston, Mr. Jones began his oil field experience with Reed Roller Bit Co. in 1934 and subsequently worked in major oil fields of Texas, Louisiana, and Oklahoma. Following overseas service with the Air Force, he joined Baroid in 1946 as a mud engineer. His initial assignment was in the Gulf Coast region, but he later spent considerable time in Mexico and South America as a consultant on unusual drilling mud problems. Following his new appointment at Baroid, he visited Mexico City and Tampico to study new developments and problems in that area.

L. W. Jones

DR. WILLIAM E. HANFORD, director of petroleum and chemical research of the M. W. Kellogg Co., New York, has been elected chairman of the American Chemical Society's Division of Polymer Chemistry for 1952. He succeeds Prof. Carl S. Marvel of the University of Illinois.

Heads Ethyl Sales

Malcolm P. Murdock, manager of the central sales region of Ethyl Corp., has been promoted to general sales manager. He will coordinate and direct the sale of antiknock compounds and a growing list of special purpose chemicals.

Mr. Murdock has had his headquarters in Chicago for the past year. Previously he was assistant general sales manager at New York. S. T. Pruitt, assistant manager of the central region, succeeded Mr. Murdock as manager.

M. P. Murdock

Schlumberger Appointments

The Schlumberger Well Surveying Corp. has announced three important changes in its field personnel.

R. D. Ford has been promoted to vice president and general manager of Schlumberger Surenco, which operates in South America. His headquarters will be in Caracas, Venezuela. Mr. Ford began his service with Schlumberger in 1936 and has been area manager at Tulsa since March, 1949.

C. K. Ruddick has been made manager of the Mid-Continent area comprising Kansas and Oklahoma, with headquarters in Tulsa. Mr. Ruddick joined Schlumberger in February, 1936. He has been assistant manager of the Mid-Continent area since May 1949.

J. A. Bodin has been made manager of the newly created West Texas area. The area office will be in Fort Worth, Texas. Mr. Bodin joined Schlumberger in France in 1933. During World War II, he served in the French Army, returning to Houston in July, 1941. He was connected with research projects until October, 1947 when he became chief field electrical engineer.

CHARLES P. BAKER, manager of the Socony-Vacuum Oil Co., Inc., refinery in East St. Louis, Ill., has been elected a member of the company's manufacturing committee and has transferred to New York. Oliver C. Johnson, operating superintendent at the refinery, will succeed Mr. Baker as manager.

Mr. Baker joined Magnolia Petroleum Co., Socony-Vacuum affiliate, at Dallas, Tex., in 1934. During World War II he served for three years as chief of the aviation section of the PAW in Washington with the army rank of major. Mr. Johnson joined the White Eagle division of Socony-Vacuum at Augusta, Kan. in 1934. He was appointed operating superintendent of the East St. Louis refinery in 1947.

K. C. HEALD, vice-president of the Gulf Oil Corp., has been designated recipient of the Sidney Powers Memorial Medal of the American Association of Petroleum Geologists. Widely recognized as the highest professional and scientific honor in the field of petroleum geology, the gold medal will be presented to Dr. Heald at Los Angeles, Calif. March 25, on the occasion of the 37th annual meeting of the association. Five other petroleum geologists who have received the medal are: Wallace E. Pratt (1945), Alexander Deussen (1947), A. I. Levorson (1948), E. DeGolyer (1950), and Max Steineke (1951).

G. R. MONKHOUSE, a 30-year man in Shell companies and presently general manager, western division of Shell Chemical Corp., has been elected vice president of the western division. His offices will remain in San Francisco. Mr. Monkhouse served three years in England, four years in India and 23 years in this country, broken only by wartime service in the U. S. Army.

G. R. Monkhouse

F. A. Davies

Cooper-Bessemer Adds To Shreveport Staff

T. M. Lamberth, Jr., has joined the Shreveport, Louisiana sales and engineering staff of the Cooper-Bessemer Corp. He will serve under the direction of A. K. DeFrance, branch manager of Cooper-Bessemer's office and warehouse facilities in Shreveport.

Named Export Head

George Gellhorn, manager of overseas distribution for the Butler Manufacturing Co., has been named manager of the company's export division. R. G. Bloomer continues as export sales manager. Mr. Gellhorn has just completed a 61,000-mile trip which covered business contacts for Butler in the West Indies, Central America, northern South America, Central Southern and East Africa, Europe and the Middle East during the past 13 months.

F. A. DAVIES has been elected chairman and chief executive officer of the Arabian American Oil Co. Mr. Davies, who had been serving as executive vice president, will devote full time to the position and will reside in Saudi Arabia. He succeeds W. S. S. Rodgers who is also chairman of the Texas Co.

W. F. Moore has retired as president of Aramco because of ill health, but will continue as a member of the board. Mr. Moore's successor will be elected in the near future. The new president, as well as the chairman, will reside in Saudi Arabia and be active in management. Floyd W. Ohliger, who has been serving as a vice president of Aramco in Saudi Arabia, was elected a director.

Results of these moves will establish in Saudi Arabia the principal executive offices of the company. Of Aramco's 24,500 employees, nearly 24,000 are stationed in Saudi Arabia. There are about 2,600 American employees in Saudi Arabia and an additional 2,000 wives and children. Some part of the 700 employees in the United States will move to Saudi Arabia.

Mr. Davies was one of the pioneers in developing Middle Eastern oil. His experience there dates back to 1930, when he went to the Persian Gulf area for Standard Oil Co. of California. He located the first wildcat well, which became a successful producer on Bahrein Island. While on Bahrein, Mr. Davies became convinced that oil could be found also on the nearby mainland of Saudi Arabia. During the period of intensive development of Saudi Arabia's oil resources, Mr. Davies has been in charge of exploration and production. He has been executive vice president since 1949 and a director since 1951.

Mr. Ohliger has been in the oil industry since 1926, having served in Venezuela, Colombia and various parts of the United States before going to Saudi Arabia in 1935. He was general manager there for Aramco before being elected a vice president in 1947. He has been in charge of concession affairs and government relations matters in Saudi Arabia in recent years.

F. W. Ohliger

Rockwell Names District Sales Manager

W. S. Andrews has been appointed New York district sales manager for Rockwell Manufacturing Co. as a part of the reorganization of the company's sales structure into five regional areas. He succeeded Mr. Harper, recently promoted to coordinate sales for the Boston, New York and Philadelphia territories.

Johnson Joins Cooper-Bessemer

Roy W. P. Johnson has been assigned to the Cooper-Bessemer sales engineering staff at its New York office. Mr. Johnson previously was an engineer with the Andian National in Colombia. Mr. Johnson is an engineering graduate of Kingston-on-the-Thames Technical College in England, and upon first coming to America was an instructor in the engineering department of the University of Toronto.

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THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

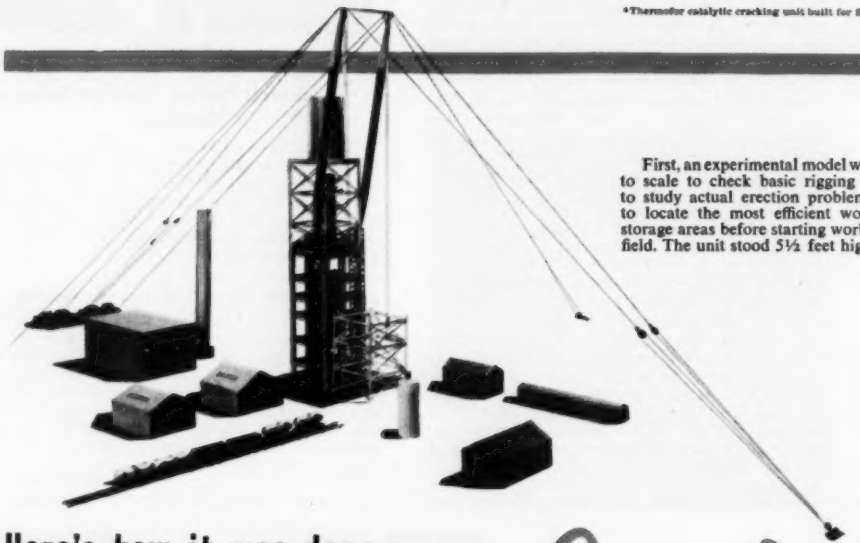
It took 60 years to save three months

on Socony's new cat-cracker*

The cat-cracker, the most important processing unit in a refinery today, is usually built from the ground up like a skyscraper—one or two floors at a time. But Fluor has developed a new time-saving technique of designing the component parts so that they can be fabricated on the ground simultaneously and lifted into place, thereby making more efficient use of manpower and equipment. Construction crews work in perfect coordination on a production-line basis to effect substantial savings in construction costs, but above all *in time!*

Fluor designed and constructed the catalytic cracking unit shown here for Socony-Vacuum at Augusta, Kansas. It stands 268 feet high, equivalent to a 22-story building. Nine months and 13 days after foundation was poured, it went on stream for 15,000 barrels a day, three months earlier than could be normally expected if built by conventional methods under similar circumstances. This airlift TCC unit processes about 1½ million barrels of oil in three months; that's why getting it into operation in the shortest possible time was an all-important objective.

*Thermofor catalytic cracking unit built for Socony-Vacuum Oil Company at their Augusta, Kansas refinery.



First, an experimental model was built to scale to check basic rigging design, to study actual erection problems, and to locate the most efficient work and storage areas before starting work in the field. The unit stood 5½ feet high.

Here's how it was done— from conception to *Completion*

October 26

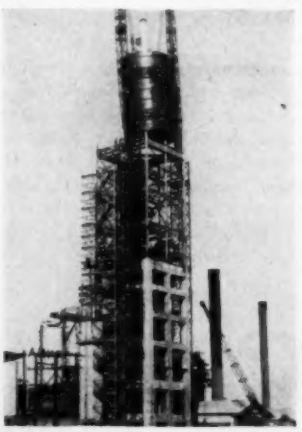
Reinforced concrete was used to a height of 100 feet for fire protection. While the base was being poured (August 21, 1950), these concrete panels weighing 85 tons each were being cast on the ground slab.

December 22

In spite of sub-zero weather, the building marathon continues. The Reactor weighing 100 tons is being hoisted 100 feet into the air. It took less than an hour to complete this operation. The cracking process takes place in this unit.

January 4

This steel section, assembled on the ground and weighing 110 tons, was lifted 160 feet and lowered into place over the Reactor. It supports the Hot Catalyst Bin. This is one of 28 major lifts varying in weight from 60 to 125 tons.



January 19

The Hot-Catalyst Storage Bin, weighing 100 tons, is now placed above the Reactor at an elevation of 165 feet. Gin poles have been jumped to a base elevation of 150 feet. Poles are now 280 feet high and carry aircraft warning lights.

February 21

This, the second steel section, 39 feet square and weighing 65 tons, is being lifted up over the Hot Catalyst Storage Bin to form the top of the structure at a height of 225 feet. Note the elevator and stairway being installed at the left.

For 60 years Fluor has been building for industry and is among the leaders in plant construction for the oil, gas-gasoline, chemical and power industries in and out of the continental United States. If time-saving is your concern, take time to contact your nearest Fluor district office for details. Write for Bulletin CC 2521 describing Fluor activity in the construction of Fluid and Thermofor cat-crackers.

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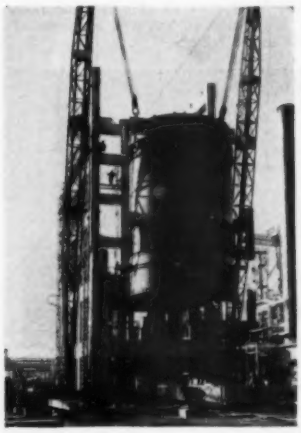
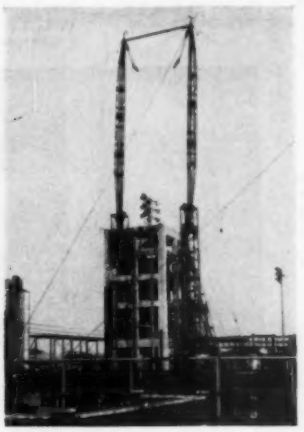


November 20

One side was left open to simplify installation of the 125-ton catalyst Regenerator, the heaviest lift. This was one of the short cuts developed while working with the model unit. This vessel, loaded with catalyst, weighs 1000 tons.



December 15

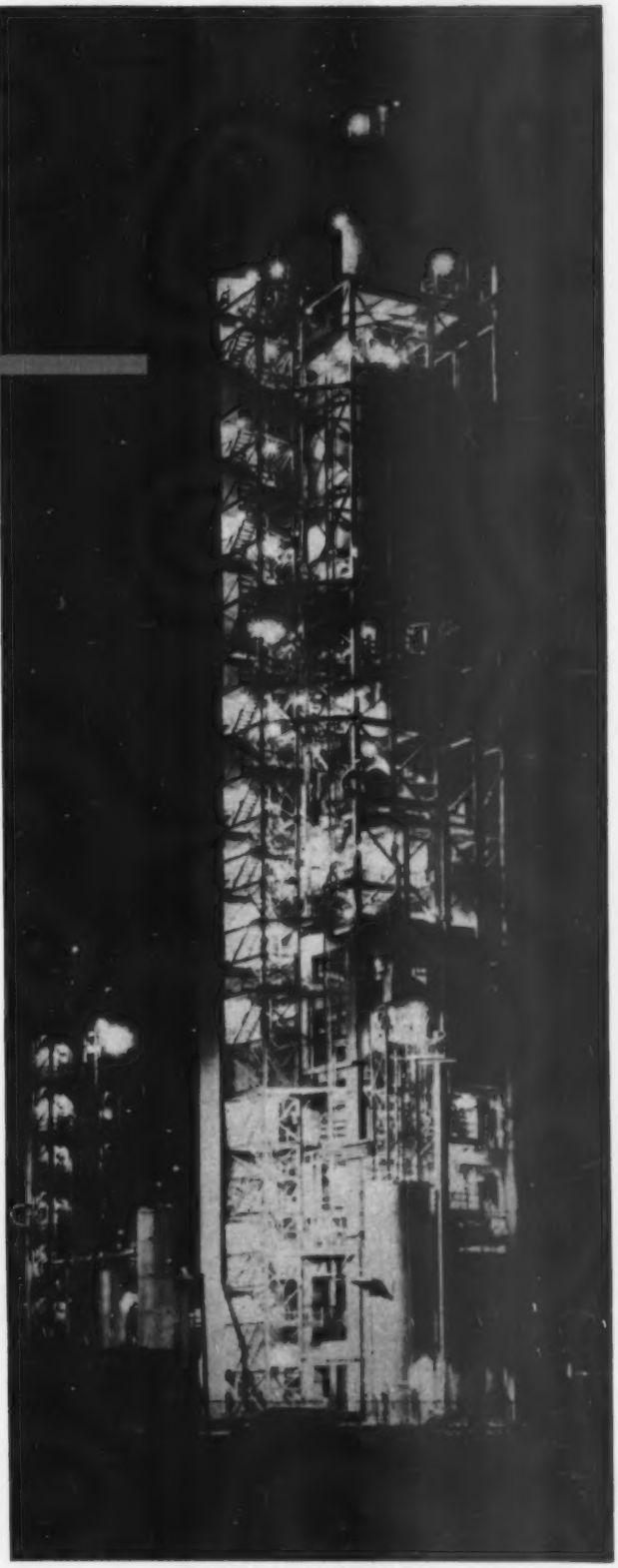
The concrete structure with pre-fabricated floors was completed. Almost 1500 yards of concrete were used for this supporting structure. The gin poles have been jumped onto specially-built towers to a 100 foot base elevation.

March 5

After the last steel section was set, the Separator Surge Drum (63 tons) is raised into place on top. This was the last lift to be made. Total height is now 268 feet, 22 stories high, and is one of the tallest structures in Kansas.

May 10

Operation testing completed and ready for start up, 9 months and 13 days after foundation was finished. This cat-cracker is capable of processing 630,000 gallons of oil every day. Fluor has four more similar units under way.



C. G. Kirkbride C. C. Peavy

Kirkbride Heads Houdry Process

Chalmer G. Kirkbride has been elected president of the Houdry Process Corp., and Claude C. Peavy vice-chairman. Clarence H. Thayer, vice-president in charge of manufacturing, Sun Oil Co., was elected a director. The reorganization was made in connection with an intensified program for the promotion of the processes licensed by Houdry.

Mr. Kirkbride has been vice-president in charge of research and development and Dr. Peavy vice-president in charge of engineering and sales of Houdry. Members of the same graduating class at the University of Michigan in 1930, both joined Houdry in 1946.

Mr. Kirkbride was the 1951 winner of the Professional Progress Award in Chemical Engineering administered by the American Institute of Chemical engineers. He is author of the book "Chemical Engineering Fundamentals," and numerous scientific papers.

Dr. Peavy started his engineering career with E. B. Badger & Sons, a construction firm, and served in Russia during the early thirties. He worked on the design of the first commercial Houdry fixed-bed units installed in 1937. He later served as chief process engineer for the Socony-Vacuum Oil Co.

MORGAN J. DAVIS, vice-president and director in charge of exploration for Humble Oil and Refining Co., will become president of the American Association of Petroleum Geologists on March 27.

Other A.A.P.G. officers elected to serve during 1952-53 include John G. Bartram, consulting geologist, Stanolind Oil and Gas Co., as vice-president; Robert H. Dott, director, Oklahoma Geological Survey, Norman, re-elected secretary-treasurer; and Kenneth K. Landes, department of geology, University of Michigan, Ann Arbor, re-elected as editor of the A.A.P.G. monthly Bulletin of Petroleum Geology. Frank A. Morgan of Richfield Oil Corp. is the retiring president.

President-elect Davis worked in the Dutch East Indies for Ned. Koloniale Petr. Mij. for five years from 1929 to 1934. Since then he has been with Humble.

EDWARD F. GUIDINGER, consultant to C. R. Musgrave, vice president supply and transportation, Phillips Petroleum Co., has retired after more than 26 years of service with Phillips. Mr. Guidinger was honor guest at a dinner on Jan. 9 at which Mr. Musgrave presided. The guest list included prominent oil men and newspaper men from all parts of the nation.

Lane-Wells Elects New Officers

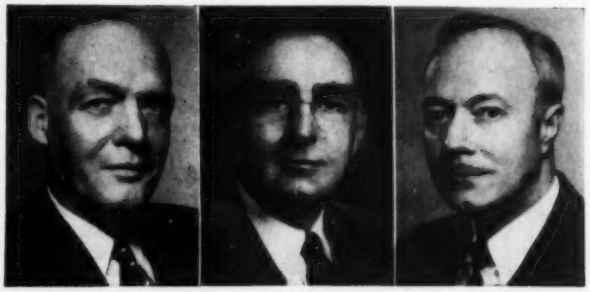
Morton T. Higgs and Dr. Russell M. Otis have been elected vice presidents of Lane-Wells Co., according to an announcement by Rodney S. Durkee, president. D. S. Jeppson, vice president, has been given added managerial responsibilities; L. H. Ingle has been appointed controller; and V. L. Forsyth has been made chief engineer.

Mr. Higgs has been in the petroleum industry since 1916, the first 14 of these 36 years with prominent oil companies as a geologist. He joined Lane-Wells as division sales manager at Houston in 1938 and has been manager of field operations for the past five years.

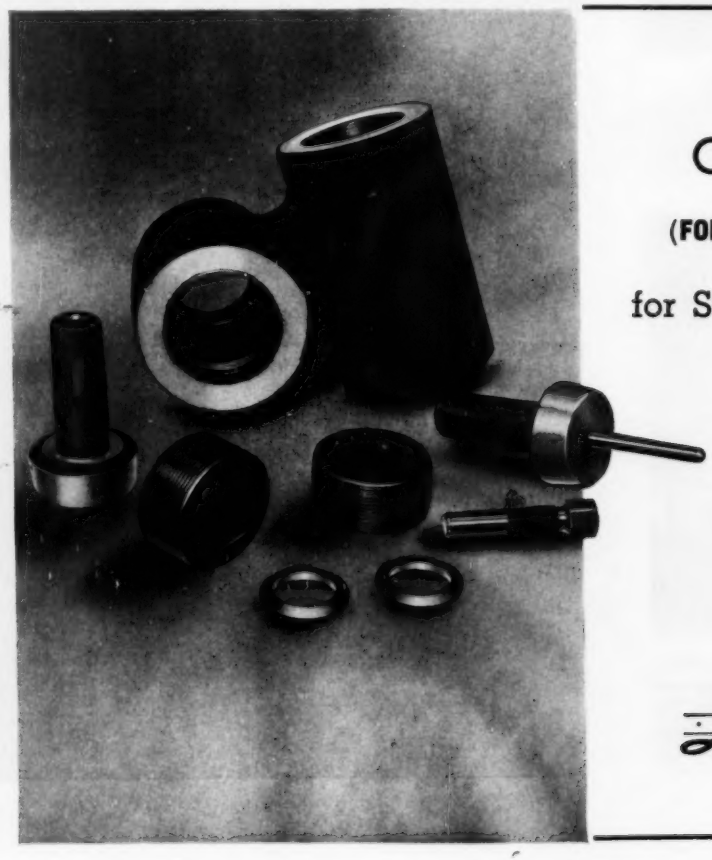
Dr. Otis, as vice president in charge of engineering, research and patents, is responsible for all phases of Lane-Wells engineering and research. He joined Lane-Wells as a research engineer in 1941, and headed the research and patent departments before gaining his present position.

D. S. Jeppson, senior vice president, has relinquished his duties as controller to L. H. Ingle, who was his assistant, to enable him to accept wider executive responsibilities.

Due to continued ill health, Norman L. Dorn has relinquished his duties as chief engineer to V. L. Forsyth, his assistant, but will continue as a vice president and director.



Left to right: D. S. Jeppson, Morton T. Higgs and Dr. Russel M. Otis, vice presidents of Lane Wells Co.



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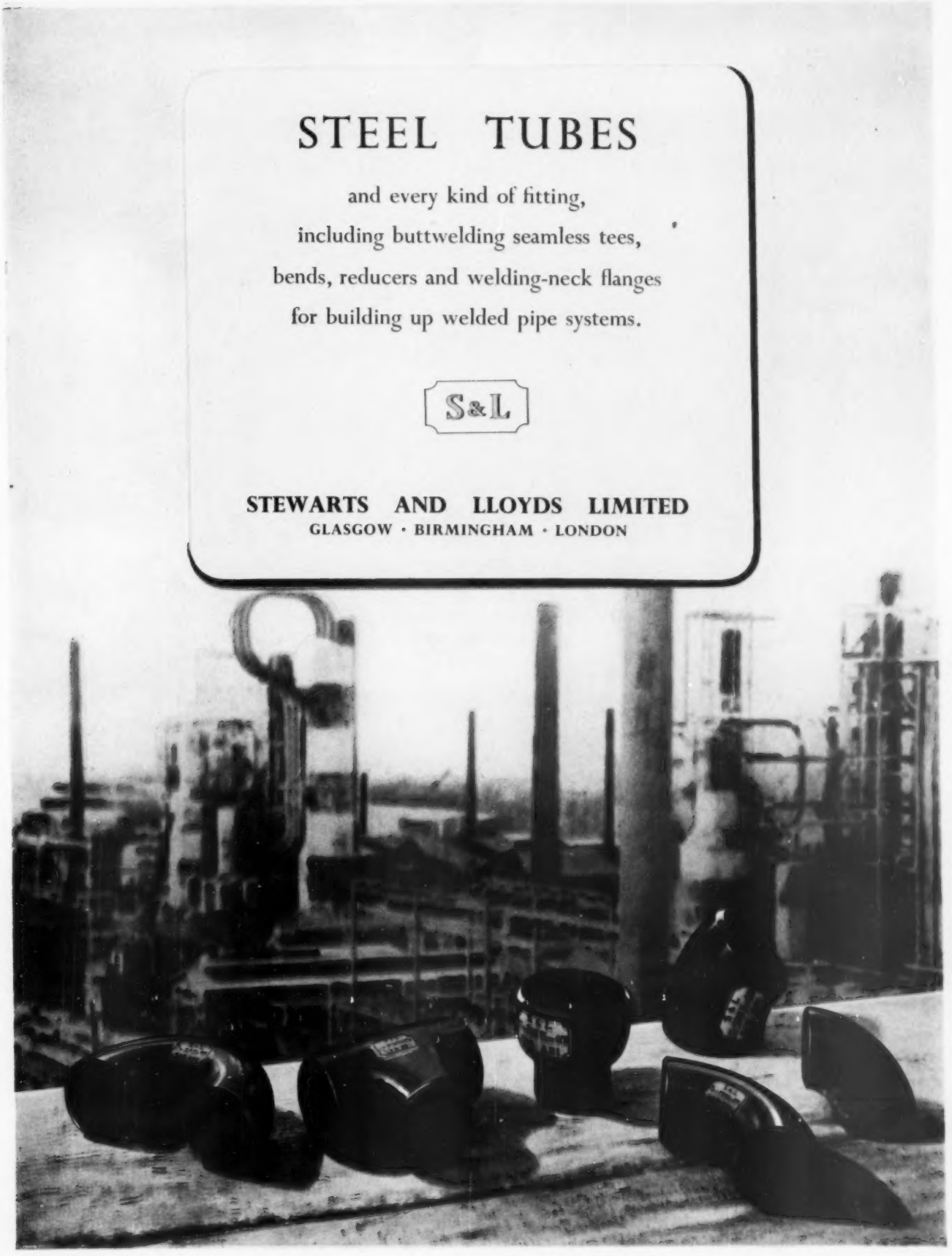

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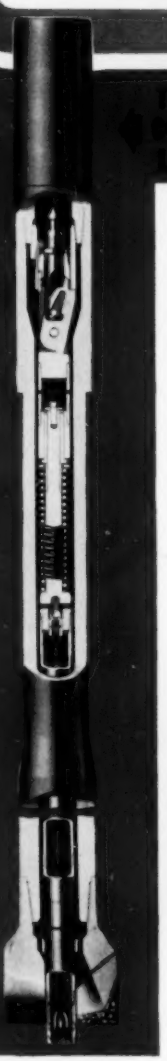
REED RESEARCH



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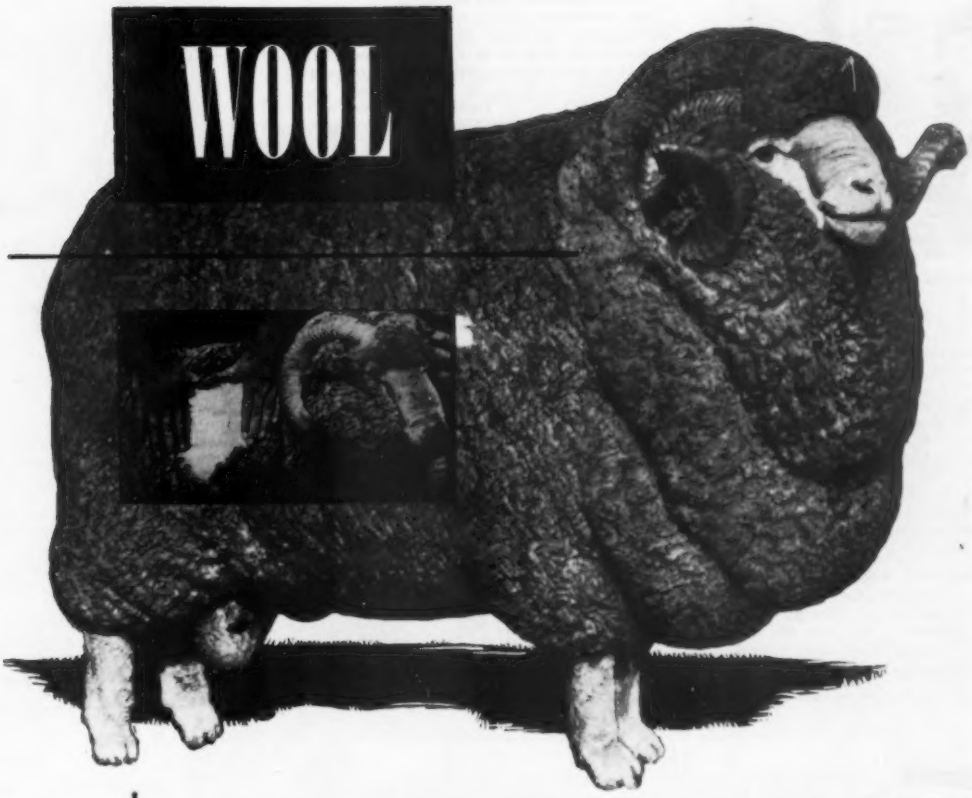

wealth of the Commonwealth

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protection and
comfort for
man, woman, child.

And, throughout the world,
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means **fine** wool...
soft, fleecy, **quality** wool.

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today provide
1 out of every 4 pounds
of the world's supply...
more than half
of all the top-quality
Merino wool.

Wool is **one-third**
of Australia's
total export trade...
accounts for **one-tenth**
of the national income.

Another mighty important
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to Australians is
OIL...

The petroleum products
which have aided
industrial expansion...
which give power,
light, warmth...
which fuel and lubricate
all manner of
modern transport.

More than a **billion**
imperial gallons
of oil products
each year
are the **life-blood**
in the arteries of
the Australian Commonwealth...
are helping to build
a stronger nation...
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for the Australian people.

In Australia, as elsewhere
in the Eastern Hemisphere,
people know
they can depend on
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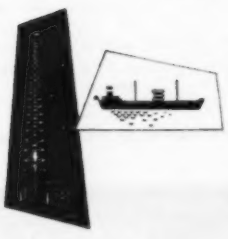
to supply this vital oil.



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SOUTH PACIFIC ISLANDS • SOUTH WEST AFRICA • TANGANYIKA • THAILAND • UNION OF SOUTH AFRICA

Charles H. Cole

CHARLES H. COLE, recently appointed assistant manager of manufacturing of Creole Petroleum Corp. in Caracas, Venezuela, joined Esso Standard Oil Co. as a student engineer in 1950 following his graduation from Worcester Polytechnic Institute. In 1935, he was made an engineer on the technical staff at the Everett refinery. Three years later he was promoted to technical assistant to the manager. Named assistant general superintendent in 1942, he assumed the post of assistant manager two years later and was appointed manager in 1945.

GEORGE N. JOHNSON has been appointed district exploration manager for The British American Oil Producing Co. at Shreveport, to succeed Guido M. Piggott. Mr. Johnson was formerly with Mid States Oil Corp. and Atlantic Refining Co. in Shreveport.

HENRY G. McBURNEY has been appointed general superintendent of the Baltimore refinery of Esso Standard Oil Co. He has been assistant general superintendent since 1949 and succeeds William J. McClintock, who resigned because of ill health. William J. Sheridan, technical assistant to the process superintendent, was named assistant to the general superintendent.

Mr. McBurney joined the company as a student engineer in 1925. In 1934, he went to the Port Jerome refinery in France as technical assistant to the manager and returned to the Technical Service Division in 1936. Named process superintendent of the Baltimore refinery in 1943, he was made assistant general superintendent in December, 1949.

Mr. McClintock has been employed by the company for more than 42 years. He joined the company as office boy in 1909. He became assistant to the Baltimore manager in 1923 and was appointed assistant general superintendent in 1943.

Henry G. McBurney

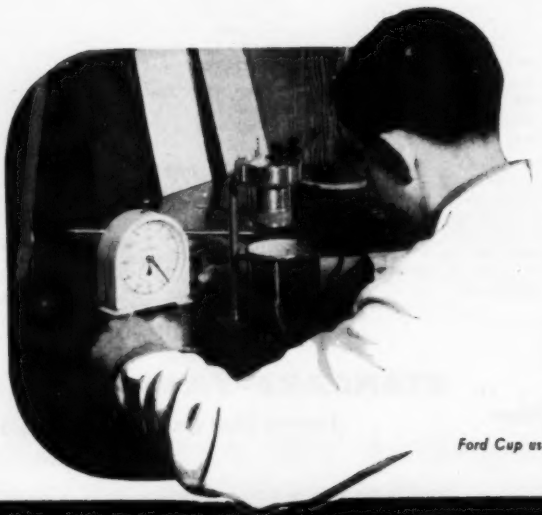
John J. Waybright

JOHN J. WAYBRIGHT, assistant to the general superintendent of the Bayway refinery of Esso Standard Oil Co., has been appointed manager of the company's Everett, Mass. refinery. He succeeds Charles H. Cole who has been named assistant manager of manufacturing for Creole Petroleum Corp., Caracas, Venezuela.

Mr. Waybright joined the company in 1934 as a student engineer. He served with the U. S. Navy in World War II as Lieutenant Commander, and was awarded the Bronze Star. In 1945, he returned to the company and was placed in charge of the manufacturing cost analysis group in New York.

EDWARD F. STOUT has been appointed a public relations representative of the General Petroleum Corp. He has been with General Petroleum since 1941 in insurance work.

THERE'S MORE IN THIS THAN MEETS THE EYE



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Three of five Cooper-Bessemer JS-8 diesels, rated 580 hp at 450 rpm, in the Catia de la Mar pumping station of the new Tacagua petroleum products line.

How they leveled out power problems on the mountain-climbing "Steep Inch"

WHAT with grades up to 45 per cent, it's no wonder the Tacagua products line is nicknamed the "Steep Inch." This new line, joint project of Creole Petroleum Corporation and Shell Caribbean Petroleum Company, rises sharply from sea level at Catia de la Mar, reaches a crest of 3,200 feet over mountainous terrain, and terminates at Caracas.

In a project like this, reliable, trouble-free power is more than ever a matter of prime importance. They played safe on this problem — picked Cooper-Bessemer diesels to do the job. The three 580 hp Cooper-Bessemer JS-8's shown above are driving pumps. Two more JS-8's drive generators for electric power requirements. They are the kind of engines you can count on for diesel performance at its best . . . any time, any place, in any service.

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San Francisco, Calif. Houston, Dallas, Greggton, Pampa and
Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La.
St. Louis, Mo. Los Angeles, Calif. Chicago, Illinois Caracas, Venezuela

T. F. LAWRY has joined Kewanee Oil Co. as Illinois division engineer with headquarters in Robinson. He formerly was chief secondary recovery engineer on the several flood projects operated by the Deep Rock Oil Corp. and has done secondary recovery for other companies.

Stone Heads Vickers Pumps

Bert L. Stone has been appointed manager of the petroleum pumping equipment division of Vickers, Inc., El Segundo, Calif. Mr. Stone has been a consulting engineer and previously general manager of Hydril Corp. for 19 years.

Vickers began manufacturing long-stroke hydraulic pumps in 1937, the first model having a 10 foot stroke. Recently the company produced a 30 foot stroke unit for Shell and General Petroleum. The unit pumps from a depth of 10,509 feet with a tapered rod string at five strokes per minute.

Bert L. Stone

Kenneth C. Towe

Towe Heads Cyanamid

Kenneth C. Towe has been elected president of American Cyanamid Co. to succeed the late Raymond C. Gaugler. Mr. Towe has been with Cyanamid since 1926. He was appointed treasurer in 1939 and promoted to vice president in charge of finance in 1945. He is a director of several associated companies including Porocel Corp., Southern Minerals Corp., Southern Pipe Line Corp., Southern Petroleum Corp., and of Cyanamid's principal subsidiaries: North American Cyanamid, Ltd., Chemical Construction Corp., and Cyanamid Inter-American Corp.

E. E. WILLIAMS, export representative for Technical Oil Tool Corp., has just returned from two and one-half months of extended field work in Canada. He will leave shortly for South America and Mexico representing Totco and Lucey Export Corp.

ROBERT E. MAPLES, formerly an instructor in petroleum refinery engineering at the University of Tulsa, has gone to Rio de Janeiro, Brazil, to supervise refinery design and construction for the National Petroleum Council of Brazil. The Council is planning erection of plants at Cubatao and Santos. Prof. Maples also will aid the University of Brazil in setting up a school of refinery engineering.

Joins BS & B At Houston

Black, Sivalls & Bryson, Inc. has appointed J. E. "Bill" White, Jr. as safety head sales representative for the Gulf Coast area with Houston headquarters.

He formerly was instrument engineer in the South American offices of Esso Standard Oil Co. and later worked as a consulting engineer in Dallas and as a salesman for Vapor Recovery Systems Co. in New York.

J. E. White, Jr.

Aviation Spirit Pump
Eminently suitable for handling spirits and other volatile fluids, this Screw Displacement Pump is of the all round clearance design and is capable of working with a high suction lift. The flow is practically pulseless and the unit self priming.
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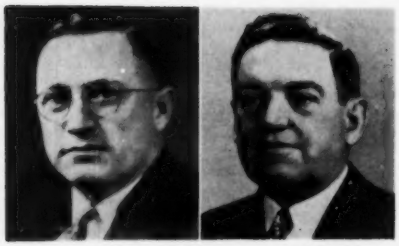

A. W. Ambrose S. B. Irelan

A. W. AMBROSE, president of Cities Service Oil Co. of Delaware, with headquarters at Bartlesville, Okla., has been elected chairman of the company. S. B. Irelan, since 1944 president of the Cities Service Gas Co., with headquarters in Oklahoma City, succeeded Mr. Ambrose. Mr. Irelan will be succeeded in the presidency of the gas company by Glenn W. Clark, since 1944 vice president and general counsel of the subsidiary.

By assuming chairmanship and turning over to Mr. Irelan the administrative direction of the company, Mr. Ambrose completes an executive reorganization program which he initiated last year and which will enable him to devote his principal attention to the extensive exploration and production activities of the company in both the domestic and foreign fields. Development work is being expanded in several important areas, including the northern Rocky Mountains, Canada, Mexico, and Venezuela.

J. D. WHEELER has been appointed assistant division manager of The Ohio Oil Company's Houston division. C. S. Mills has been named district manager at Midland, Texas, succeeding Mr. Wheeler. D. W. Franklin, geologist at Abilene, Texas, succeeds Mr. Millas as district geologist at Midland.

WALTER S. HALLANAN, of Charleston West Virginia, has been chosen for a sixth consecutive term as chairman of the National Petroleum Council. He has held this non-salaried position since the formation of the council in 1946, having been unanimously re-elected each succeeding year. He is president of Plymouth Oil Company and other affiliated companies.

DR. ARTHUR B. HERSBERGER, who has been manager of the chemical products section of the domestic sales department of The Atlantic Refining Co., has been appointed manager of the company's product sales division. He is succeeded in his former post by John Martin Hoerner, formerly sales supervisor in the chemical products section. Dr. Hersberger joined Atlantic in 1936 as an associate chemist.

Dr. Arthur B. Hersberger

J. A. Costello B. B. Turner S. M. Wagner

JOSEPH A. COSTELLO, B. Bynum Turner, and Sanford M. Wagner have been elected directors of Ethyl Corp. Each is a vice president in charge of operating functions within the company.

Mr. Costello, who is responsible for the coordination and planning of the corporation's activities, has been associated with Ethyl since 1928. He was elected a vice president in December 1949.

Mr. Turner, who is vice president in charge of research and engineering, Joined Ethyl in 1946. He was named general manager of manufacturing in 1950, and in June 1951 was elected a vice president. During World War II he served with the Rubber Reserve Co. as head of its butadiene-from-petroleum section.

Mr. Wagner, vice president in charge of sales, joined the corporation in 1926, less than two years after it was first organized. His entire career with Ethyl has been spent in the sales department, and he was largely responsible for the introduction of "Ethyl" gasoline on the West Coast. Mr. Wagner was elected a vice president in January 1950.

H. J. McCUSKER has been elected treasurer of Cities Service Co. to succeed Ernest H. Johnston, who retired February 1. Mr. McCusker has been with Cities Service since 1919 and became assistant treasurer in 1942. Mr. Johnston was with Cities Service for 45 years. He has been director since 1916 and became treasurer in 1945.

Descale WITHOUT Danger

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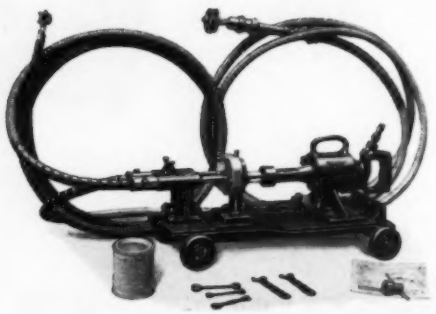
Use AIR-DRIVEN "SKATOSKALO"

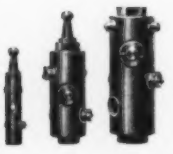
THE Air Motor "Skatoskalo" Set enables the operators to de-scale and clean tubes in the shortest possible time with the greatest efficiency. The air motor gives more horse-power and does not stall when heavy deposit is encountered.

The Air Motor Driven Set incorporates all the advantages of a Rotary Air Tool without sacrificing the advantages of the electrically-driven Flexible Drive type.

"Skatoskalo" equipment can be used with complete safety and is recommended for the efficient maintenance of cracking plant, boilers, evaporators, condensers, heat exchangers, etc.

Tubes of 5/8" internal dia. upwards can be thoroughly cleaned by "Skatoskalo" Air Tools.





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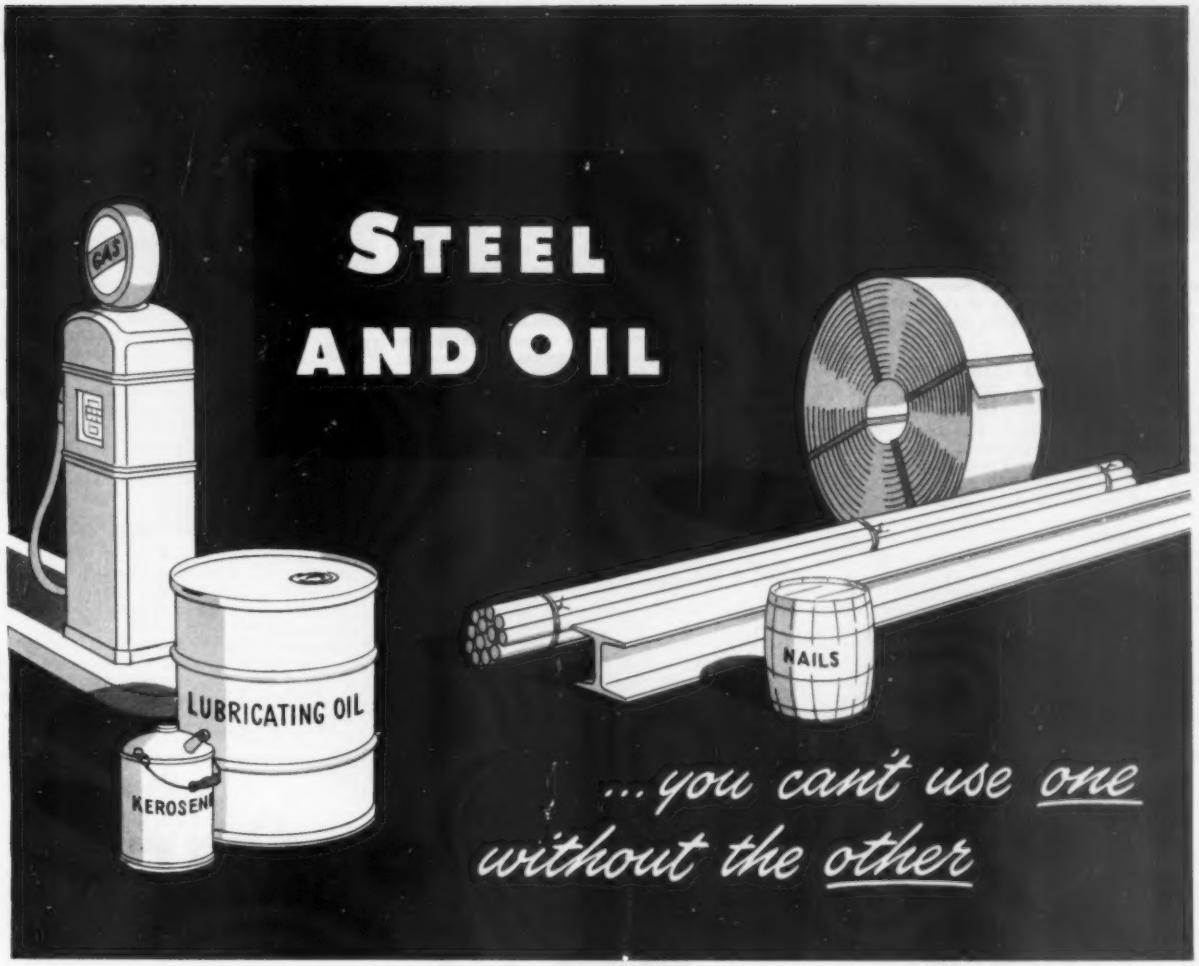

McKee builds the plants that produce them

IT'S virtually impossible to find a place where steel is used without the use of some petroleum product in its production, fabrication or operation. It is just as hard to name a use for gasoline or oil without steel in the picture.

Steel and Oil—these are industry's "inseparables" and they are needed today in greater quantities than ever before.

The McKee organization has designed and built hundreds of plants in the United States and some 25 foreign countries and is now engineering new facilities which will account for a definite increase in the production of iron and steel and petroleum products.

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Headquarters: McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio. *New York Office:* 30 Rockefeller Plaza, New York 20, N.Y. • *Washington Office:* 1507 M Street, N. W. Washington, D. C. • *England:* The Iron and Steel Division of Arthur G. McKee & Company is represented by Head, Wrightson & Company, Ltd. *District Engineering Offices:* Union, New Jersey and Tulsa, Oklahoma.

J. S. Fluor, center, president-elect of the engineering and construction firm, is shown conferring with D. W. Darnell, chairman of the board, and J. R. Fluor, right, executive vice-president.

Fluor Officers Promoted

J. S. Fluor has been elected president of the Fluor Corp., Ltd., Los Angeles engineers, constructors, and manufacturers, to succeed D. W. Darnell who was elected chairman. Mr. Darnell replaces Shirley E. Meserve, senior partner of Meserve, Mumper and Hughes, Los Angeles law firm, who will continue as chief counsel and member of the board.

Further organizational changes included the election of J. Robert Fluor to the office of executive vice-president, formerly held by J. S. Fluor. James P. Wiseman, vice-president, and Francis E. Fischer, secretary-treasurer, were re-elected to their respective posts. Fluor's new president is the son of J. Simon Fluor, founder of the firm. He joined the company in 1921, and in 1929 was named assistant general manager and vice-president. Since 1944 he has served as executive vice-president.

The total volume of work completed by Fluor during the past fiscal year amounted to $52,269,394, with net profit after taxes totalling $1,136,417. Present backlog of work orders is in excess of $100 million, which is the largest in the history of the firm.

Upon assuming the presidency, J. S. Fluor said that the company planned to open an office in Toronto, Canada, in the near future, and will move into a new building March 1 at Houston, Texas, where the corporation maintains its Mid-Continent division headquarters.

LP-Gas Sales Up 25.9 Percent

Sales of LP-Gas increased 25.9 percent in 1951 to 4.1 billion gallons, according to estimate of George R. Benz and K. W. Rugh of Phillips Petroleum Co. Home and farm use including motor fuel sales reached 2.9 billion gallons, an increase of 32.5 percent. There are now eight million homes using LP-Gas served by 4,500 bulk plants.

Motor fuel use of LP-Gas increased sharply in 1951 as more buses and farm tractors were put into use. More than 1,000 city and inter-city buses using propane as fuel have been put into service in the past 18 months. Use of liquefied gases for chemical manufacture increased 22.5 percent in 1951 to 750 million gallons.

At the end of the year there were 12,643 tank cars in LP-Gas service. Phillips is preparing to pump the product to Chicago from Texas by pipe line. Intracoastal movement by barge is increasing.

BS&B Opens San Francisco Office

Black, Sivalls & Bryson, Inc., Kansas City, has opened another new California sales office at San Francisco. Announcement was recently made of the opening of a Los Angeles office. Ross Baze, west coast sales manager, Los Angeles, will be in charge of the San Francisco office, locally assisted by Warren J. May, sales engineer.

Geology Chair At Rice Institute

Rice Institute has been given 20,000 shares of Humble Oil & Refining stock valued at $1,570,000 to establish a chair of geology. The gift was made by Mrs. Olga Kieth Wiess in honor of her late husband, Harry C. Wiess, former Humble president. Mr. Wiess was a Rice trustee when he died August 26, 1948. During his lifetime he and Mrs. Wiess made several large contributions to Rice. The gift will provide an annual income of $50,000. It is planned to conduct special research in marine geology and to employ a distinguished geologist to occupy the new chair.

Rocky Mountain Products Line

An 8-inch products pipe line from Sinclair, Wyo., to Salt Lake City, Utah, will be built by Continental Oil Co. and Sinclair Oil Corp. The new line will be about 310 miles in length, and will cost approximately $8 million. Capacity will be 12,000 b/d. Pioneer Pipe Line Co. has been formed to build and operate the line, the capital stock of which will be owned 65 percent by Continental and 35 percent by Sinclair.

A Salt Lake City terminal will be built and the new line will tie in with the Salt Lake Pipe Line Company's line which extends from Salt Lake City to a point on the Columbia River.

Opens Denver Offices

Southern Geophysical Co. of Fort Worth and Midland has announced the opening of division offices in Denver to service rapidly growing Rocky Mountain operations. Elmer F. Blake, who has been with Southern for three years, will be in charge of the Rocky Mountain division with offices at 504 Denver Theater building. Southern Geophysical Co. now has several crews operating in Montana, Wyoming, Colorado and surrounding states.

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OIL ENGINES
FOR
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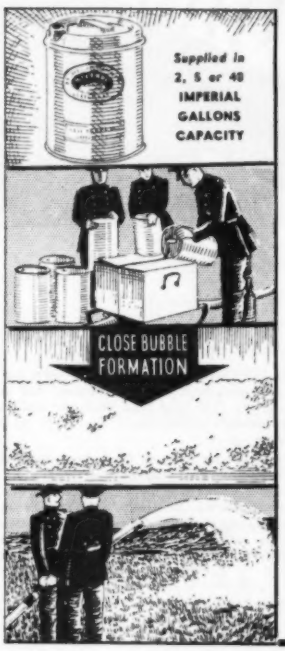

★ Nicerol is supplied in heavy gauge steel drums designed for quick release and clean pouring.

★ Nicerol can be used in any type of mechanical foam or air foam apparatus. In this case a base injection type in-line inductor is being operated.

★ The secret of Nicerol effectiveness lies in the small bubble formation. It creates a tough, efficient blanket. 3 gallons of Nicerol and 100 gallons of water will produce over 1,100 Imperial gallons of foam.

★ The above petrol and oil blaze was extinguished in a matter of seconds by a normal mix of Nicerol Foam Compound.

Meet the hazard of fire with Nicerol, the foam compound that kills any oil or petrol fire quickly and absolutely. Nicerol is a concentrate, producing a heavy type foam of closely-knit small bubbles which form a tough, vapour-tight blanket over the surface of burning oil or petrol. It is characteristic of Nicerol Foam that it flows with the fire and is highly resistant to flash-back or re-ignition. It can be used successfully in any type of mechanical foam or air-foam apparatus — is equally effective with salt water or fresh and can be stored for years without deterioration.

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* This new Kellogg design for Fluid Hydroforming is solidly based on unduplicated experience and data. Kellogg designed and built the first Hydroforming unit in 1940, and then designed and built all but one of the subsequent units—more than 90% of the world's total capacity.

The Fluid catalyst principle employed in the new process was rapidly brought into commercial use by Kellogg, as evidenced by the fact that more than 70% of the world's Fluid catalytic cracking capacity is Kellogg-engineered. Naturally Kellogg has been in the forefront of the development of Fluid Hydroforming, has obtained much data from the company's pilot plants over a period of years, and has access to all important data pertaining to the subject.

True Continuous Operation . . .

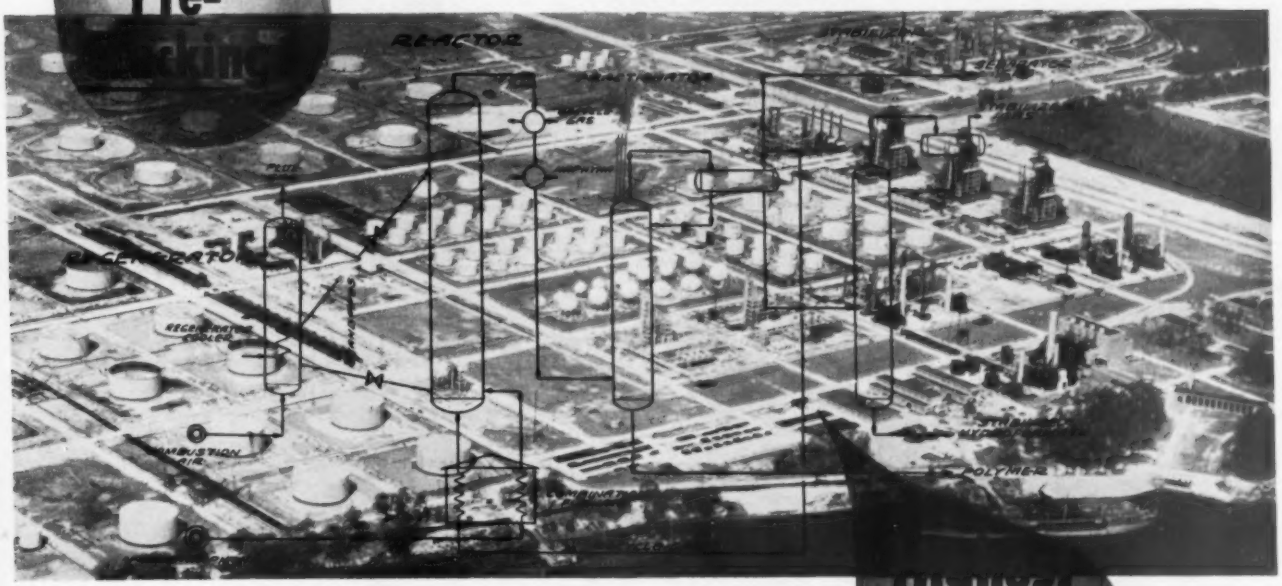
Reduced Pre-

A truly continuous process, *Fluid* Hydroforming stands today as possibly the most important single refining development since Fluid catalytic cracking.

Fluid Hydroforming offers the refiner a naphtha upgrading process at considerably reduced investment cost in comparison with conventional fixed-bed reforming processes. Its operating cost is lower. But probably most important is the fact that Kellogg Fluid Hydroforming has a higher octane "ceiling" than any other process of its kind, principally because of its continuous regeneration feature.

Fluid Hydroforming is adaptable to a wider range of feeds than other naphtha processes. Feed stocks ranging from hexane (for benzene production) to kerosene can be employed if desired.

The process can be employed effectively to upgrade virgin heavy naphthas, and is especially effective on high-sulfur cracked naphthas or a mixed virgin and cracked feed.



Highest Octane Ceiling

New Kellogg-Designed Fluid Hydroforming Units in Work

- ★ **2,000 BPD UNIT** for Gulf Coast refiner to upgrade straight run naphthas to produce aviation stock
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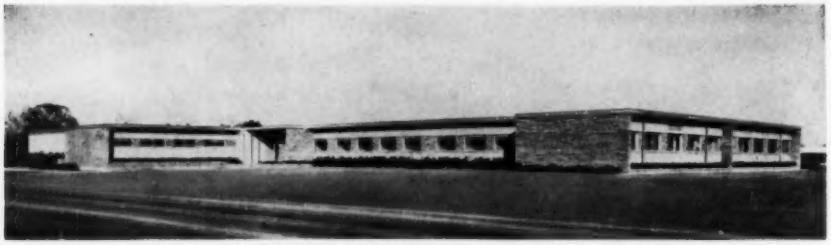

New office building of Lummus Company's Houston, Texas, branch.

New Lummus Building at Houston

The Lummus Co. has moved its Houston, Texas, branch organization into a new office building recently completed for the company at 2707 Weslayan Road, Houston. Dedication ceremonies, followed by an "open house" reception, were held February 1, with C. A. Barrere, vice president, who is in charge of the Houston office, as host. The branch now houses a heavy concentration of design, engineering and construction functions, plus the various service departments to support them—a complete team for handling a project from start to finish.

"Meet The Lummus Company" is the title of a 16-page brochure just published for free distribution. Separate sections picture and describe each branch office, affiliate, laboratory and manufacturing arm of this world-wide firm. Text outlines scope of work performed by each, with photos of projected or completed plants as illustrations.

To Build North Dakota Refinery

Standard Oil Co. (Ind.) considers the Williston Basin such a promising source of crude oil that it intends to build a new refinery with a capacity of 15,000 barrels per day in North Dakota. A definite site will be selected soon.

To Enlarge Phillipsburg Refinery

Cooperative Refinery Association, Kansas City, Mo., will build a Universal Oil Products fluid catalytic cracker with complete gas concentration and polymerization units at its Phillipsburg, Kansas, refinery. Plans also include a gasoline treater for sweetening the catalytically cracked gasoline. The new cracking plant is designed to process cracking stock from 10,000 barrels per day of crude oil at 75 percent conversion. Crude capacity at completion of the expansion program will be 8,000 b/d with an ultimate crude capacity in excess of 10,000 barrels per day. Contract for the construction has been let to The Refinery Engineering Co., Tulsa.

To Expand Refinery

Continental Oil Co. will spend approximately $7,500,000 on an expansion program in its Ponca City refinery, largest of the company's eight plants.

Major project in the Ponca City refinery expansion will be the construction of new coking equipment of the continuous contact type at a cost of approximately $3,550,000. An electric turbine generator, a high-pressure steam boiler and auxiliary equipment for the power plant, and a lubricating oil additives plant will be installed.

Builds New Chemical Plant

Phillips Chemical Co., wholly owned subsidiary of Phillips Petroleum Co., is building a plant for producing ammonia, methanol, and other chemicals made from petroleum raw materials. The new plant will be located on a 500-acre tract adjoining the present ammonium sulfate plant on the Houston Ship channel. The new facilities are expected to serve as a basis for the future manufacture of a wide variety of petrochemicals.

Oil and Gas Law Symposium

A symposium on Oil and Gas Law will be held at the University of Kansas City on May 16, Marlin M. Volz, dean of the School of Law, announced. Among the subjects to be discussed will be: unitization, leasing of the public domain, percentage depletion tax problems, and oil and gas royalties. The symposium will be open to any persons interested as well as attorneys.

Entrance to auto tour bureau in Sinclair Refining Company's new headquarters building in New York. Telegraphic road reports from all sections of the country announce detours and aid in planning tours.

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BAR TYPE PLUG PULLER

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EAR TOP RETURN
BENDS

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- Cannot damage the Return Bend Seat or Plug
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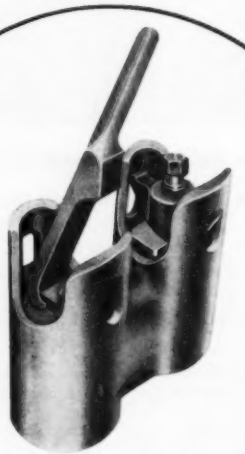

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To make sure you get the right steel, go to the metallurgists of The Timken Roller Bearing Company. They're recognized authorities on high temperature steels. With 20 years experience in research and with 23 different analyses at their disposal, they'll help you select the one best steel for your operating conditions. And you're assured of uniform, high quality steel in every tube because of the Timken Company's rigid quality control from melt shop through final tube inspection.

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This month's report is on: **DM STEEL**

Has unusually high creep strength for a pearlitic steel, good stability up to 1200°F., fairly good corrosion and oxidation resistance. Has 2 to 3 times the life of carbon steel where corrosion is not severe. Recommended for cracking furnace tubes, hot oil lines, superheater tubes, high temperature steam piping and forgings for accessory parts.

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2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	

*Not available as seamless tubing at the present time.

Pictured above is a direct-reading spectrometer, used in the Timken Company's Spectrographic Laboratory. It chemically analyzes a molten heat of Timken steel in just 40 seconds, makes possible precise control of the steel's properties.

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(Advertising Agencies in Italics)

American Cyanamid Company 40
Hazard Advertising Co.
Anglo-Iranian Oil Company 87
S. H. Benson Ltd.
E. B. Badger & Sons 30
Harold Cabot
Thames Advertising Service Ltd.
Baroid Sales Division, National Lead Co. 117
Darwin H. Clark Co.
William Barret Company 91
Bozell & Jacobs (La.) Inc.
Bethlehem Steel Company 14
Gotham Advertising Company, Inc.
British Ropes, Ltd. 85
D. J. Keymer & Co. Ltd.
Burton, Delingpole & Co. Ltd. 23
S. H. Wright & Co. Ltd.
California Texas Oil Co., Inc. 2
Cunningham & Walsh, Inc.
Carbometals Ltd. 93
Renson Advertising Ltd.
Chicago Bridge & Iron Company 1
Russell T. Gray, Inc.
Cooper-Bessemer Corporation 105
The Griswold-Eshleman Co.
Crane Packing Ltd. 4
Crossley Premier Engines 110
Osborne-Peacock Co. Ltd.
Davey, Paxman & Co. 9
E. I. du Pont de Nemours & Co. 17, 18
Charles L. Rumrill & Co.
Ethyl Corporation 3
Batten, Barton, Durstine & Osborn
Filtrol Corporation 29
Heintz & Co., Inc.
Flexible Drives Ltd. 108
Boswell & Barratt Ltd.
The Fluor Corporation Ltd. 98, 99
Dozier, Eastman & Co.
Foster-Wheeler Corporation 38
Albert Frank-Guenther Law, Inc.
The General Electric Company Ltd. 97
Greenly's Ltd.
Geolograph Company 88
Lowe Runkle Company
Graver Tank & Manufacturing Co., Inc. 13
Simmonds & Simmonds, Inc.
Halliburton Oil Well Cementing Co. 16, 42
Bachrodt, Newell, O'Kane & Gano
Hill & Christopher
G. A. Harvey & Co. (London) Ltd. 25
Humble Oil & Refining Co. 10
Wilkinson-Schiwetz & Tips, Inc.
Hurst-Nelson & Company Ltd. 85
Osborne-Peacock Co. Ltd.
International General Electric Co. 76
Grant Advertising, Inc.
International Harvester Co., Inc. 6
McCann-Erickson Corporation
International Paints Ltd. 104
Mayfair Advertising Ltd.
M. W. Kellogg Company 112, 113
Gordon Baird Associates, Inc.
William Kenyon & Sons 7
Rowlinson-Broughton
Lake & Elliot Ltd. 100
London & Midland Steel Scaffolding Co. 19
S. H. Wright & Co. Ltd.
The Lummus Company 21
Harris D. McKinney Organization
Arthur G. McKee & Company 109
Meerman's, Inc.
Magnet Cove Barium Corporation Cover III
Rives, Dyke & Company
Marine Exploration Company 37
Rives, Dyke & Company
Lee C. Moore & Company, Inc. 83
Watts, Payne Advertising, Inc.
Newman Hender & Company Ltd. 15
Nicerol, Limited 111
Townsend-Smith, Ltd.
Oil Center Tool Company 39
Rives, Dyke & Company
Samuel Osborn & Company Ltd. 114
Ospina-Racines, Publisher 88
Petty Geophysical Engineering Co. 107
Wallace Davis & Company
Petroleos Mexicanos 118
Petroleum Information 95
Procon, Incorporated 33
Simmonds & Simmonds, Inc.
Pyrene & Company Ltd. 24
Nelson Advertising Service Ltd.
Robert H. Ray, Inc. 88
T. Page Rogers Advertising Agency
Reed Roller Bit Company 102
Brennan Advertising Agency
Rheem Manufacturing Company 36
Campbell-Ewald Company, Inc.
Schlumberger Well Surveying Corp. 75
Rives, Dyke & Company
Security Engineering Co., Inc. 27
The McCarty Company
Seismograph Service Corporation 31
Watts, Payne Advertising, Inc.
Sydney Smith & Sons, Ltd. 81
S. H. Wright & Co., Ltd.
Socony-Vacuum Oil Company 12
Compton Advertising, Inc.
Southern Geophysical Company 8
Cowan-Gilliam Advertising Agency
Southwestern Industrial Electronics 34
Rives, Dyke & Company
Spirax Manufacturing Company 93
Harry Dawson Advertising
Standard Oil Company (N. J.) 5
McCann-Erickson Corporation
Standard-Vacuum Oil Company 103
Sam J. Gallay Company
Stewarts & Lloyds, Ltd. 101
H. Raymond Morgan
Stothert & Pitt, Ltd. 106
Telegraph Construction & Maintenance Co. Ltd. 93
G. Street & Co., Ltd.
John I. Thorncroft & Co. Ltd. 89
Timken Roller Bearing Company 115
Batten, Barton, Durstine & Osborn
United Geophysical Company 78
Dozier, Eastman & Company
United Steel Companies 35
Rowlinson-Broughton
Universal Oil Products Company 22
Simmonds & Simmonds, Inc.
Varley Pumps & Engineering, Ltd. 92
Warren Petroleum Corporation Cover II
Gibbons Advertising Agency
G. & J. Weir 94
Scottish Industrial Advertising
Western Geophysical Company 32
L. J. Swain, Advertising
White Motor Co. 26
D'Arcy Advertising Co.
Willys-Overland Export Corporation 11
Ewell & Thurber Associates
George Wimpey & Sons 95
Wyatt Metal & Boiler Works Cover IV
Wallace Davis & Company
Youngstown Sheet & Tube Company 20
The Griswold-Eshleman Co.

Book Review

Introduction To Geophysical Prospecting, by Milton B. Dobrin. Published 1952 by McGraw-Hill Co., New York; 435 pages, $7.00.

This is a book directed especially at students of geology and mining who expect to enter the field of petroleum exploration, and professional geologists, mining engineers, or executives in control of exploration whose work involves contact with geophysics, and who have the final responsibility of acting on the results of geological and geophysical prospecting. To bring the subject within the reach of the majority of such persons, no mathematics are introduced beyond what is required of professional geologists — trigonometry and algebra which are sufficient for practical evaluation of geophysical data. The fields of gravity, magnetic, and seismic exploration are extensively covered, with less emphasis on electrical, radioactivity and geochemical prospecting. Higher mathematics are of course required of the professional geophysicists; this book aims to help mathematicians of a lesser order to understand and act on what the geophysicist has produced.

Gas Turbine and Jet Bibliography

Bibliography of Books and Published Reports on Gas Turbines, Jet Propulsion, and Rocket Power Plants, by Ernest F. Fiock and Carl Halpern, National Bureau of Standards Circular 509, superseding Circular 482, 111, 64 pages, 20 cents (27 cents foreign). (Order from Government Printing Office, Washington 25, D. C.)

In addition to presenting references to published sources of information, the bibliography includes a brief introduction on the classification and rating of jet engines and a discussion of the scope and arrangement of the references. The bibliography also covers the present and future development, theory and performance, materials and construction, and research programs in the fields of gas turbine and jet propulsion. Since the gas turbine and the jet engine may in the future utilize energy from nuclear fission, some references in this field are included.

Development of the Modern Gas Engine

"The Modern Gas Engine," a paper presented at the Oil and Gas Power Conference of the ASME by Ralph L. Boyer and W. R. Crooks of The Cooper-Bessemer Corp., has been published in bound form. The paper provides data, photographs and charts on the development of the large internal combustion engines used for pipe line transmission service and electric power generation. It discusses also the installation and operating economies of different types of design on their various services. Copies are available by writing The Cooper-Bessemer Corp., Mount Vernon, Ohio.

Book Review

Texas Almanac and State Industrial Guide. Published 1951 by Dallas Morning News, Dallas, Texas. 674 pages.

This handbook bears the sub-title "The Encyclopedia of Texas," and the information it gives about the people, history, institutions, vital statistics, government, education, agriculture, industry, mineral resources (including oil) of the Lone Star State is truly encyclopedic. The ten-page closely printed index shows an infinite variety of items which even a browsing reader may enjoy.

Diesel Bulletin

Design and operation features of the Nordberg one, two and recently introduced three cylinder Type 4FS Diesel engines are illustrated and described in a new 12-page Bulletin 194 published by Nordberg Manufacturing Co., Milwaukee 1, Wis. The units range from 10 to 45 hp within an operating speed range of 1,200 to 1,800 rpm.

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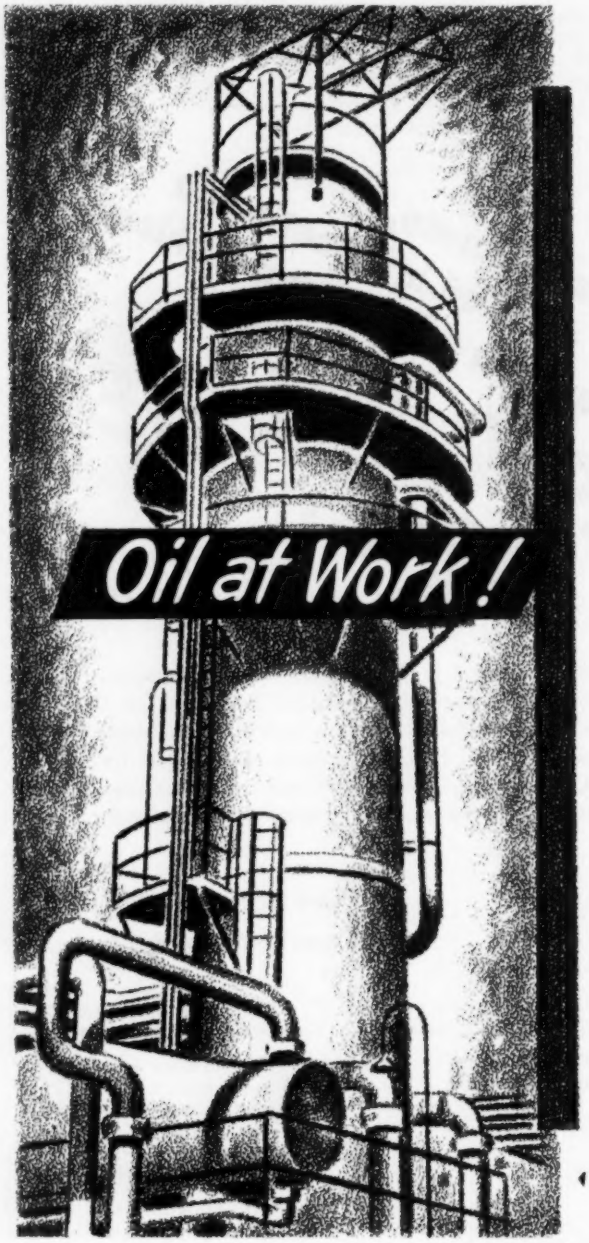

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Thirty years ago, the fabulous early Mexican oil fields produced at a rate that reached 530,000 barrels a day.

But, both directly and indirectly, Mexico gets far more out of a present production rate of 230,000 barrels a day.

Directly: Taxes from oil in 1921:
69 million pesos
Taxes from oil now:
505 million pesos

Indirectly: U. S. goods sold in Mexico in 1921:
$217 million
U. S. goods sold in Mexico now:
$700 million

Mexican buying power is not only much greater now but it is better distributed because of the development of *all* phases of the Mexican economy. Oil serves the specific requirements of this development. More than three out of four barrels of oil are refined and put to work in Mexico . . . leaving a still important volume for export.

Oil is at work. The results are evident.

PETROLEOS MEXICANOS
MEXICAN PETROLEUM ADMINISTRATION
Producing More and Distributing Liberally

◀ *Girdler reactivating unit at Poza Rica*

Opens North Dakota Office

Stanolind Oil and Gas Co. has opened a new exploration district office at Bismarck, N. D. T. S. Yancey, district landman, formerly at Abilene, Texas, will be in charge of the Bismarck office, which will be located in suite 312, Petroleum Bldg., 222 Main Ave., Bismarck, North Dakota.

NGAA Expands Analysis Research

Furthering its effort to eliminate human errors in low temperature analysis of hydrocarbon mixtures, the fractional analysis committee of the Natural Gasoline Association of America has begun the distribution of two more liquid samples of undisclosed composition to the 61 oil companies and commercial laboratories participating in the research program. Purpose is to assess the improvement in accuracy made by participating laboratories as a result of previous studies and seminar discussions of errors.

Harris Buys Southern Geophysical Stock

Dr. Sidon Harris, president of Southern Geophysical Co., has purchased all of the company's outstanding stock, formerly held by National Geophysical Co. and associates. Directors of Southern Geophysical are Dr. Harris, chairman, R. H. Danna, W. D. Baird, R. E. Davis, E. F. Blake, L. R. Sarazan, and E. G. Aycock. Southern Geophysical was organized in June, 1945 by Dr. Harris, and has grown to 17 seismograph field crews.

Moves Catalyst Sales Offices

National Aluminate Corp. has opened sales offices in New York City at 141 East 44th Street, according to an announcement by Gage Averill, sales manager of the catalyst division. Mr. Averill moved his own headquarters from Chicago to New York on February 1st. Plant facilities are at Chicago.

Kellogg Enlarges Laboratories

Petroleum and chemical laboratories of The M. W. Kellogg Company are described in the current issue of "Kelloggram" just published. It reveals that Kellogg is now expanding the Jersey City laboratories about 50 percent in order to cope with the increased requirements for pure research as well as engineering development.

Dresser Annual Report

Substantial gains in both sales and earnings together with a significant improvement in the overall financial position and an increase of 123 percent in its backlog of unfilled orders are revealed in the 1951 annual report of Dresser Industries, Inc. Dresser's net 1951 earnings after taxes were $5,115,547 on sales of $106,148,484, compared with $4,303,043 net on sales of $79,968,546 in 1950. On a common per share basis, earnings for 1951 were $3.77 compared with $3.15 in 1950.

A WORD ABOUT THE PIPE SITUATION

- MAGCOBAR
- MAGCOGEL
- HIGH YIELD
- MAGCO-FIBER
- XACT CLAY
- FIBER SEAL
- SALT GEL
- MY-LO-JEL
- RED OX
- MAGCO-MICA
- TANNATHIN
- JEL-OIL MUD
- JEL-OIL "E"
- "E" CONCENTRATE
- NOHEEVE
- SEAL FLAKES
- MAGCO-PHOS
- QUEBRACHO
- CHEMICALS

Magcobar
Complete
DRILLING MUD SERVICE
DEALER

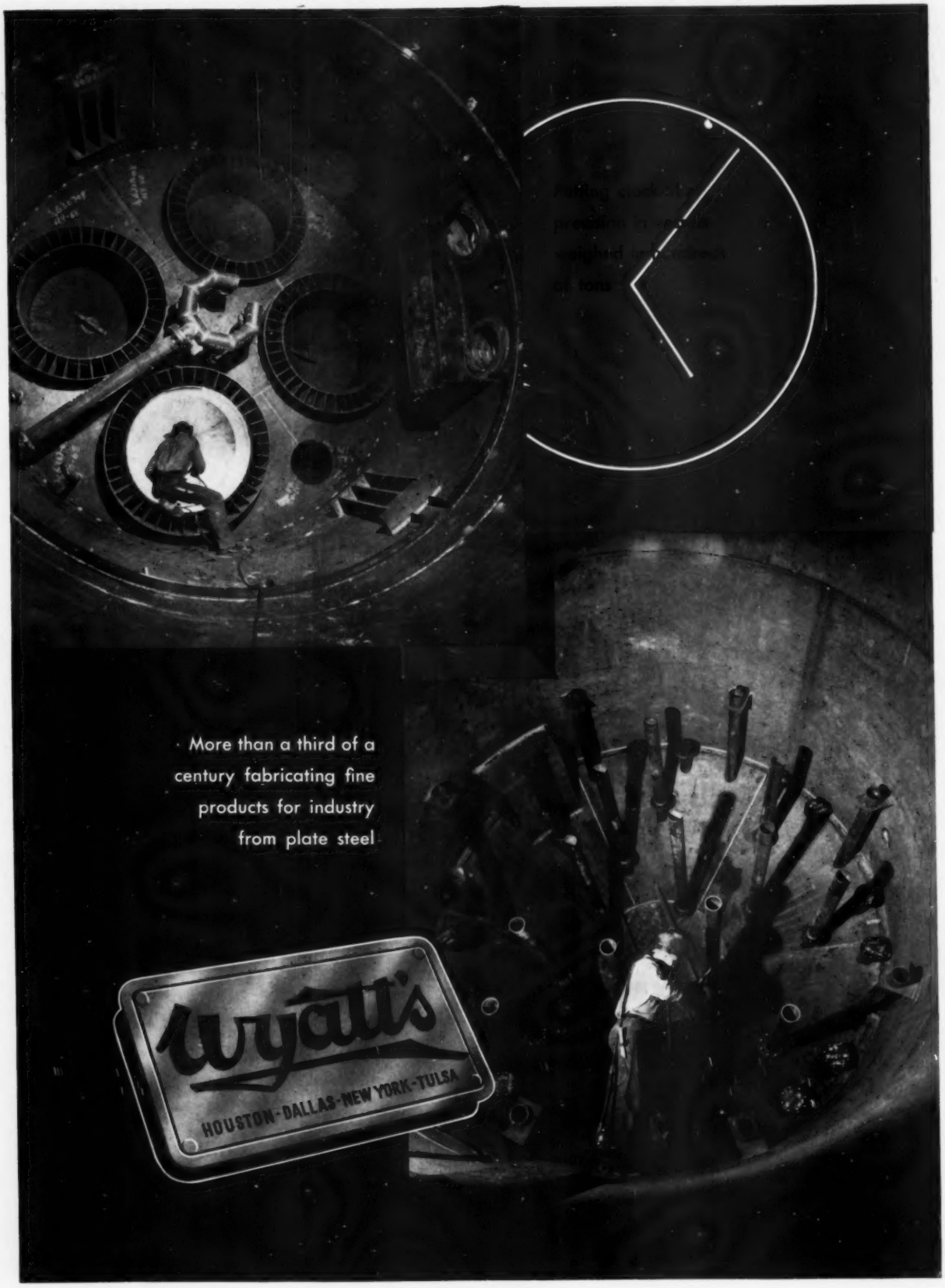
PROTECTIVE MUD CAN OFTEN REPLACE PROTECTION CASING, ALLOWING YOU TO DRILL MORE WELLS WITH YOUR PRESENT CASING ALLOCATIONS.

During 1951 enough steel was allocated to the petroleum industry to drill approximately 43,400 wells. Figures to date indicated that more than 46,000 wells will be drilled before the year ends.

It's a safe assumption that carefully planned drilling mud programs have played a big part in saving the steel necessary for the drilling of these 2600 extra wells.

There are many drilling conditions under which you can stretch your present casing allocations to include extra wells by using protective mud to replace protection casing. Ask your Magcobar field engineer to give you specific examples of how some wells can be drilled without protection casing.

MAGNET COVE BARIUM CORPORATION
ONE OF THE DRESSER INDUSTRIES
HOUSTON, TEXAS • MALVERN, ARKANSAS


More than a third of a
century fabricating fine
products for industry
from plate steel
Wyatt's
HOUSTON-DALLAS-NEW YORK-TULSA